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Engineering

ELECTRICAL WORLD

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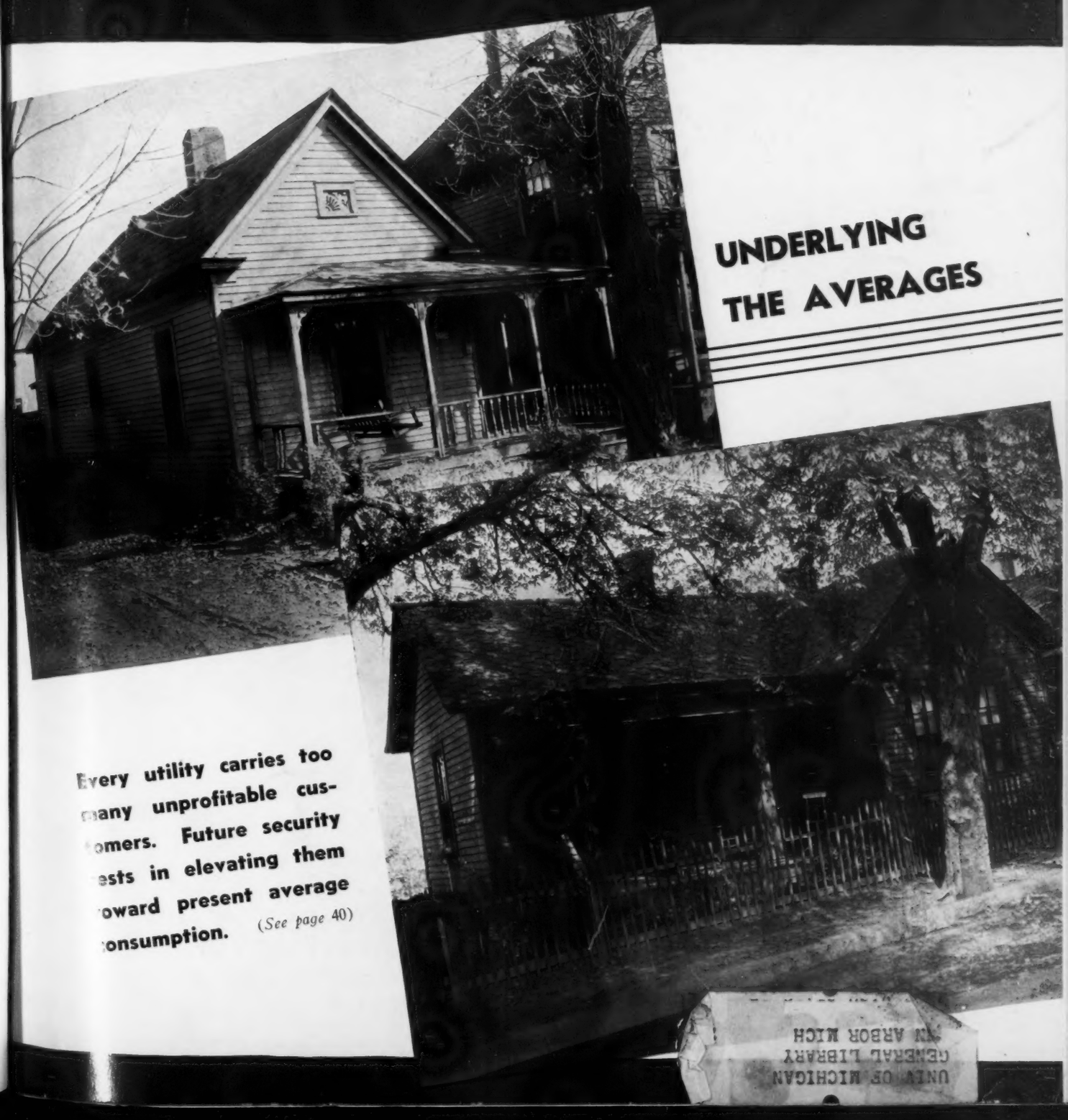

UNDERLYING THE AVERAGES

Every utility carries too many unprofitable customers. Future security rests in elevating them toward present average consumption. (See page 40)

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Synchronism Without Mechanical Connection

Hints on the application of synchro-tie drives to tension and constant speed tasks.

Power Factor, Power Bills and Low Voltage

Power-factor correction is reflected in improved voltage conditions on the plant distribution system and improvement in the power bill.

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NEWS OF THE WEEK

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VOLUME 107 . . . NUMBER 5

Contents Copyrighted, 1937, by McGraw-Hill Publishing Company, Inc.

ELECTRICAL WORLD—Published every Saturday. Price 25 cents a copy. Subscription rates: United States, Canada, Mexico, Central and South American countries, $4 a year; all other countries, $6 or 24 shillings a year. Entered as second-class matter November 16, 1936, at Post Office at Albany, N. Y., under the Act of March 3, 1879. Printed in U. S. A.

Branch Offices: 520 North Michigan Ave., Chicago; 883 Mission St., San Francisco; Aldwych House, Aldwych, London, W.C. 2; Washington; Philadelphia; Cleveland; Detroit; St. Louis; Boston; Atlanta, Ga.

McGRAW - HILL PUBLISHING COMPANY, INC.

Publication Office: **99-129 North Broadway, Albany, N. Y.**

Editorial and Executive Offices: **330 W. 42d Street, New York, N. Y.**

JAMES H. McGRAW, JR., Chairman — MALCOLM MUIR, President — JAMES H. McGRAW, Honorary Chairman

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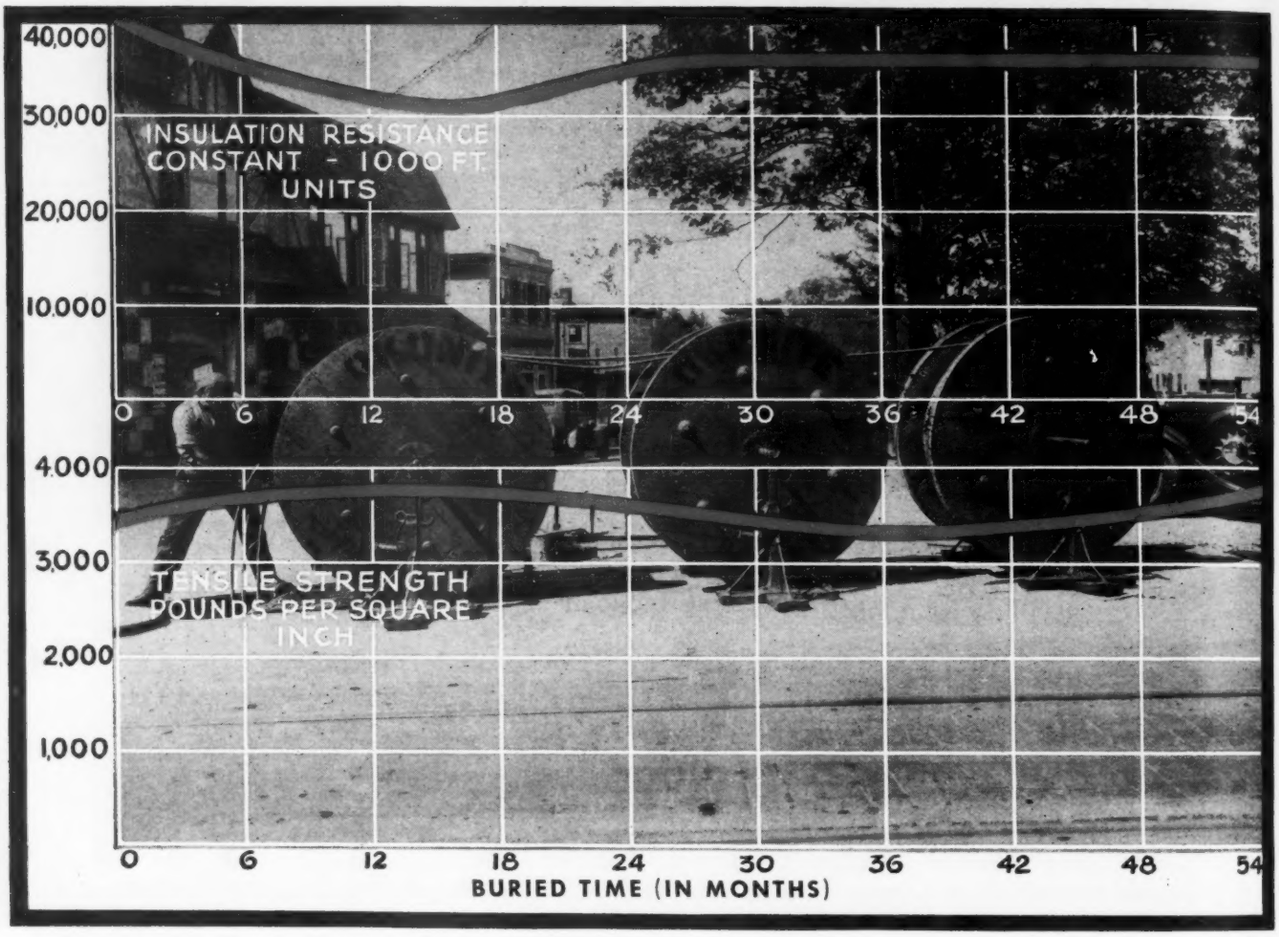

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Note: The above chart appears in our latest booklet on Okosheath, which will be mailed upon request.

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OKONITE QUALITY CANNOT BE WRITTEN INTO A SPECIFICATION

ELECTRICAL WORLD

JANUARY 30, 1937

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Private Ownership Will Not Take the Count

Two schools of political thought respecting the relationship of government to power service have been freely expressed in Washington during the past two weeks. Both aim at eventual public ownership, one as a gradual evolution and the other quickly, in the spirit of retaliation because of alleged failure on the part of utilities to co-operate with the government.

Some newspaper commentators have seized upon this political objective as the beginning of the end of private ownership of utilities. Perhaps Washington would like to see that idea generally accepted, but the fact remains that the wish is still father to the thought.

That this country, and in fact the whole world, is in a new social and economic era has to be acknowledged. Likewise, one must acknowledge the folly of blind opposition to the new conditions. The order of the day is intelligent adaptation of business to these conditions, not as an expedient, but as an acknowledgment of the permanency of the march of social progress.

On the other hand, it must be remembered that those intrusted with the direction of public utility properties are not their own masters. They are the stewards of the investors' money. They would be grossly negligent if they did not protect those properties against any threat. And it has been with that consideration that utility executives have gone into court to defend the rights of stockholders and bondholders in the properties they manage against governmental agencies that would impair or destroy that investment.

How can such action be construed as lack of co-operation? The whole situation can be likened to a condition of unemployment. If a person out of work were to attempt to take away or injure the property of a citizen, would the latter, because he resisted, be guilty of non-co-operation in helping to solve the unemployment problem?

Today the administration is facing the problem of unemployment of federally owned power. To accuse the utilities of lack of co-operation because they resist efforts of the government to take away their markets and destroy their investment is ridiculous. If the utilities were unwilling to help the government market this power, then there might be some basis for the charge. The fact is that utilities have always been ready to act as such marketing agencies.

As time goes on, the government will come to understand that the private utilities are the most practical outlets for the huge federal undertakings. They can distribute the energy cheaper and better, and instead of receiving a subsidy out of federal funds will, in fact, enrich national and local treasuries through taxes.

It is difficult, therefore, to get alarmed that private ownership will take the count. It will not. It has its problems to meet, of course, and among them will be more and more regulation, a constant drive for lower rates, and higher taxes. These, however, are problems of management and have no relation to the fundamental problem of public views of private ownership.

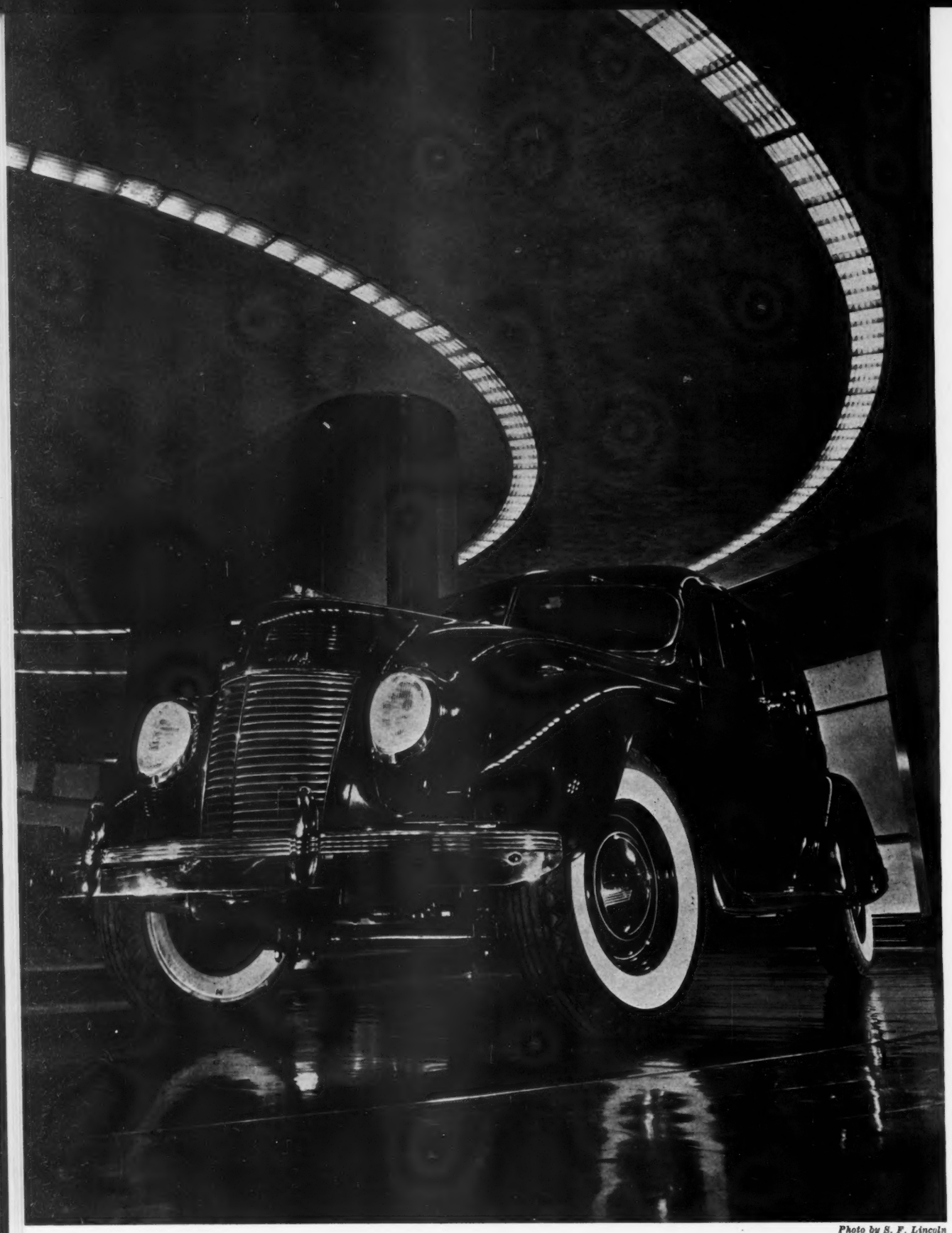


Photo by S. F. Lincoln

UTILITY MERGED WITH DECORATION

Chrysler showroom has 15-ft.-candle floor lighting from flush lowered ceiling lights in circles to match turntable. Essential side lighting obtained from panel lights in pillars.

Interconnection Provides Superior Protection

No Cure-all Is the Interconnection of Arrester Ground With Secondary Neutral, but Transformers and Fuses Can Be Saved and Service Interruptions Reduced

By

H. R. WILBUR . . . F. COX

Metropolitan Edison Company, Easton, Pa.

IN THE year 1925 it was decided to adopt 4,600 volts as a distribution voltage. The smallest transformers used were 3 kva. and the management felt that, for reasons of economy, it was desirabie to install them without lightning arresters, but the experience of the next lightning season showed that the omission of arresters was a mistake because of the very large percentage of transformers that had fuses blown during lightning storms. Accordingly, arresters were installed as promptly as possible on all transformers not equipped with them.

In 1928, with arresters on practically all transformers, the losses from burned-out transformers and interruptions due to blown fuses caused by lightning were still very high. To secure information which would help in improving this situation a policy was adopted of measuring the ground resistance on each installation where a transformer was damaged or its fuses blown by lightning. Reports of these tests showed that no cases of trouble were occurring where the ground resistance was below 60 ohms and few cases where it was below 100 ohms.

With this information at hand, the natural result was an endeavor to correct the troubles by lowering ground resistance. During 1929 and 1930 the policy was followed of driving multiple grounds and of treating the earth to increase its conductivity. Check measurements made after completion of this work showed that in many instances, due to certain types of earth formation, it was impossible to get satisfactorily low resistances, resistances often being as high as 200 to 300 ohms after treatment. It was also found that the lowered resistance obtained by treating was not permanent and could only be maintained by periodic retreatment. It being apparent that satisfactory results could not be obtained by the above methods, attempts were made to find some other means of eliminating this transformer and fuse trouble.

At this time the possibility of increased protection by means of interconnecting the lightning arrester ground to the secondary neutral was called to our attention. It was decided to interconnect the transformer at one location where three transformers had been burned out during the early part of 1931. Exposure to lightning was extremely bad at this location and the ground resistance over 200 ohms. Since interconnection there have been no failures at this location. During 1932 and 1933 several additional transformers having records of repeated failure were similarly protected.

Ten years of experience with troublesome lightning conditions led to the adoption and trial of numerous protective methods by this company. Actual results of interconnection, used in conjunction with arresters and good grounds, are described in this article.

The results obtained in these cases were so satisfactory that beginning with 1934 it was decided to apply this protection to all transformers. This was carried out by making the applications first in the areas of worst exposure, with an effort to so proportion the expenditure that it would be practically self-liquidating on the basis of the reduced cost of transformer and fuse maintenance. By April 1, 1935, 77 per cent of all transformers were interconnected, and by the first of August practically all transformers were interconnected.

A summary of the results obtained with interconnection during the past three years is shown in Table I. For purposes of comparison of the general lightning conditions of the season the last line on this tabulation gives the number of electrical storms recorded throughout each season in this area. Table II is a study of the various cases where transformers failed or transformer fuses were blown due to lightning, analyzed from the standpoint of the type of connection. Table III is a correlation of transformer

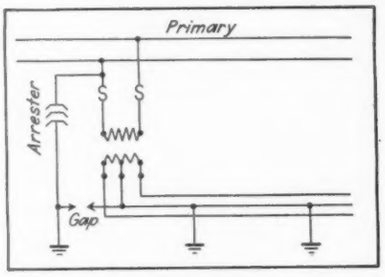
Table I—Transformer Failures and Fuse Operations

	1933	1934	1935
Transformers in service (total)	2,349	2,420	2,374
Transformer kva. in service (total)	38,652	38,545	38,457
Transformers in rural area	.....	.....	1,442
Tranformer kva. in rural area	.....	.....	12,876
Percentage with lightning arresters	98	99	100
Number of transformers interconnected	90	330	1,839
Transformer burnouts (total)	25	23	20
Kva. burnout	136	87	68
Transformer burnouts (rural)	23	22	16
Lightning burnouts (total)	22	12	9
Lightning burnouts (rural)	20	12	8
Lightning burnouts without arresters	1	1	0
Lightning burnouts with interconnection	0	4	9
Lightning fuse operations (total)	91	54	39
Lightning fuse operations (rural)	81	48	35
Lightning fuse operations without arresters	5	6	3
Lightning fuse operations with interconnecton	0	7	36
Total lightning interruptions	113	66	48
Total lightning interruptions per 100 transformers	4.82	2.68	2.06
Number of storms	26	32	25

failures and fuse operations during lightning storms with the number of switch operations on the 33-kv. transmission system during the same storms.

The total number of transformer burnouts and fuse failures due to lightning during 1935 is particularly noticeable in contrast with the conditions prior to 1930. In this earlier period it was not unusual to lose as many as ten or twelve transformers and blow from 100 to 200 fuses in a single severe lightning storm, so that. aside from the reduction in expense of having to go out and replace transformers or fuses, the improvement in service to customers and the stopping of loss of revenue during the period while they were out of service has been very considerable.

The theory is becoming generally accepted that insulation can successfully withstand impulse voltages far in excess of its normal breakdown point, provided the time of application is sufficiently short. It is also becoming recognized that while insulation may successfully resist such momentarily high voltage applications, nevertheless these high voltages have a deteriorating effect on the insulation and continued applications of them gradually reduce the dielectric strength of the insulation so that



Interconnection diagram as employed by Metropolitan Edison Company—Use of isolating gap is optional

eventually the insulation may fail at lower voltages than that of the dielectric test which it is required to pass on manufacture.

Acceptance of this theory regarding insulation strength leads to the acceptance of the theory that successive high voltage surges impressed on a transformer over a considerable period of time will actually shorten the life of the insulation and hasten the time at which the transformer will actually fail. For this reason one should not be mislead by the good results obtained with interconnections and think that the efficiency of the primary lightning arrester installation is not of importance. On the contrary, every effort should be used to see that the primary lightning arresters are of the most efficient type and ground resistances as low as can practicably be secured in order to keep the impressed surge voltage on the transformers to the lowest possible level.

Some engineers are of the opinion that with interconnection burnouts of the electric meters due to lightning may be greatly increased. This has not been the case to date on this system.

In studying this report of failures it should be borne in mind that a great many of these transformers have previously been subjected to many severe surge potentials due to lightning and that the addition of interconnection can do nothing to restore the dielectric strength in the transformer to its original value, and that, therefore, over a period of years we should still expect a reasonable number of failures of these older transformers. The same reasoning holds true as regards fuses, since, when the transformers were interconnected, the existing fuses were not renewed. Some of these fuses had already been subjected to severe overload currents in previous lightning storms, which, however, were not severe enough to blow the fuse. It can be expected that some of these fuses will blow in subsequent storms. While fuses are usually blown by power-follow current and not by lightning surge currents, recent tests have shown that lightning strokes may produce currents in excess of 10,000 or 15,000 amps. In cases where the fuses are connected ahead of the arresters such currents may blow the fuses.

It is felt that the results shown by this report indicate the desirability of 100 per cent interconnection. How-

[*Continued on page* 88]

Table II—Summary of Interconnection of Transformers That Failed and Blew Fuses—1935

	Neutral Arresters	Solid	None	Total
Transformers	8	1	0	9
Fuses	33	2	4	39
Both	41	3	4	48

Note:

1. Lack of interconnection in four cases was as follows:
   - 2 Three-phase banks—10 kva. rural and 3 kva. urban.
   - 1 Street light tub—3 kva. urban.
   - 1 Arrester not connected to line—3 kva. rural.
2. Of the nine transformers reported burned out, four were found on test to require new bushings only and after repairs were returned to service.

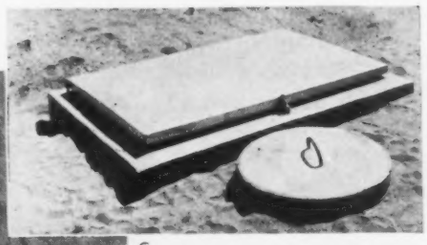
Table III—Correlation of Line Trip-Outs With Transformers and Fuse Interruptions Caused by Lightning During 1935

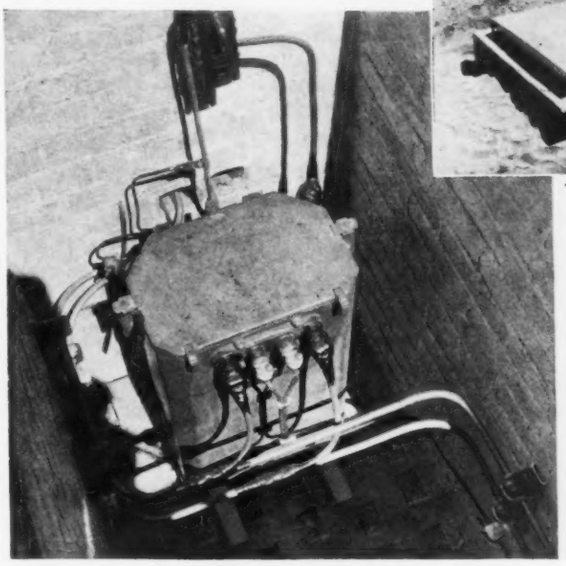
Date	Line Trips	Transformer Failures	Fuse Operations	Total Transf. and Fuses
3/23	2	0	0	0
4/29	3	0	0	0
4/30	1	0	0	0
6/17	6	0	2	2
6/19	1	0	0	0
6/27	12	2	4	6
6/29	3	0	0	0
6/30	2	0	7	7
7/8	8	0	2	2
7/12	7	1	1	2
7/15	1	0	0	0
7/16	0	1	1	2
7/18	0	1	0	1
7/19	3	0	1	1
7/20	25	0	6	6
7/21	2	0	0	0
7/23	24	2	9	11
7/24	0	2	1	3
7/25	2	0	1	1
8/1	14	0	2	2
8/14	0	0	1	1
9/21	2	0	0	0
10/23	0	0	1	1
10/30	1	0	0	0
Total	119	9	39	48

Low-Cost Underground Used at Palm Springs

Single-Duct System Installed for 59 Cents per Foot, Including Risers, Ducts, Manholes and Service Boxes—Satisfactory Operation Proved for Low Rainfall Areas

By C. N. PARKER
Nevada-California Electric Corporation, Riverside, Calif.





Concrete brick transformer manhole. The circular vault in the foreground is a telephone service box and is similar to the service boxes installed by the power company

Underground transformer manhole for dry climate.

Note method of draining through a grate and gravel bed, the cable connections and the cable hangers

RESIDENTS of Palm Springs, Calif., America's foremost desert resort, demand that the scenic setting of this beautiful spot be unmarred by wires, poles and other appurtenances usually associated with electrical service facilities. Fortunately, the inhabitants can afford to gratify their whims and their desires have been met by the Southern Sierras Power Company engineers, who have designed a residential underground system incorporating unusual features which can be installed for a very moderate cost.

The policy of the Southern Sierras Power Company in serving this residential underground has been to require the owner or subdivider to pay the difference between the allowance for overhead lines and the cost of the underground duct and cable system. Under these conditions a large part of the underground system has been installed by subdividers and the cost added to the price of the land. In the past two years more than 20,000 ft. of primary or secondary duct line has been installed at an average cost of 59 cents per foot of single duct for the underground duct system, including risers, ducts, transformer manholes and service boxes. This cost is being reduced on the latest jobs. The installed cost of the duct line alone is from 35 to 45 cents per foot of single duct, depending on the soil conditions.

Palm Springs, Calif., lies on a gentle slope at the foot of towering Mount San Jacinto, while toward the rising sun stretches the sand and sage of the desert. The soil is soft, golden sand in some places and in others the rocky wash from the palm-filled canyons. The low average annual rainfall of 3.16 in. makes possible an underground system of the type used. In spite of the depression, many subdivisions have been laid out in the past few years and a large number of new homes built. At present residential building under construction amounts to more than half a million dollars.

The duct lines of the system are constructed of 3½-in., square-bore, slip-glazed, vitrified tile in standard 30-in. lengths with the ends doweled together and made tight with gaskets and a wrapping of asphalt-impregnated fabric. Ducts are laid carefully to a uniform grade with a minimum slope of 1 per cent, and the top of the duct is kept a minimum depth of 24 in. below the ground level. As most of the excavation and laying of ducts is done by contract, a profile survey is made and obstructions (other than rocks) are located in advance by the company's engineers. Grade stakes and "cuts" are usually placed at 50-ft. intervals. Rocks and boulders are generally encountered below the ground surface. At street crossings the tile is protected by a 2-in. plank covering.

At each pull or service box location a 6-in. bed of tamped, crushed rock is placed below the level of the duct line for drainage. Upon this bed one or more layers of machine-made, concrete half-bricks, such as are commonly used in house construction in Palm Springs, are laid in a circular form with a cement mortar. One or more lengths of 24-in. I.D., tamped, concrete tile are set on end on this brick base, the whole being of such height as to bring the top of the tile from 6 to 9 in. above the natural ground level. The single tile duct line entrance replaces one of the half-

[*Continued on page 88*]

This Water Heating Business

Rates, Methods of Control, Hours of Operation and Other Pertinent Factors to Be Considered in the Development of the Water Heater Load

Acknowledgments are due the manufacturers for the production of a satisfactory storage heater. Prices are fairly reasonable, but would be lower were it not for central station idiosyncrasies. "Rugged individualism" seems to have degenerated into whimsical egotism, manifested in more or less trivial demands upon manufacturers for departure from standard models. For example, one large manufacturer is forced to carry upward of 600 catalogue items or numbers of electric water heaters. This is downright silly, and we in the central station industry who are responsible for the situation ought to correct it.

By W. H. HODGE
Vice-President Byllesby Engineering & Management Corporation, Chicago

ESTIMATED SALES of storage type electric water heaters were 10,000 in 1932. They climbed to 70,000 in 1935, may reach 100,000 in 1936. That's how the business is growing. Lowered rates and low-priced selling campaigns in response to demands for larger consumption volume are the reasons. Such has been the experience of the Northern States Power Company and other utilities.

This particular use of electricity is in its infancy. There were only 260,000 electric water heaters of all types in the United States the first of this year (manufacturers' estimate). Eighty per cent were the automatic storage type. There was only one water heater installed for every four electric ranges in use—a poor showing when it is considered that it is the addition of the water heater which frequently swings electric cooking customers over to the profit side of the ledger. No one seems to know how the ratio stands in the gas industry, but I'll venture the guess that it is about one to two of all types of heaters.

About 40 per cent of total household electric customers now have water heating rates available; that is to say, a rate of about 1 cent or less. No considerable volume can be hoped for at a higher rate. Even then electric water heating is a luxury in the great majority of homes which can afford it. There are numerous ways of heating sufficient water to live in moderate comfort cheaper than electric water heating. Cut out those who cannot possibly afford it—those who live in apartment buildings with a central hot water supply and those who prefer gas, coal or liquid fuel for a complete household service—and the present market for electric water heating narrows down considerably. There still remains however, a very large and highly profitable market awaiting development.

Four fundamentals govern sales development: First, electric water heating must be sold on a competitive basis and at an installation and operating price a considerable number of people can afford; second, the only way we can price it to meet these conditions is to concentrate energy supply during hours of the day when the demand or load on the system is in the valley period; third, the hot water storage principle is the only practical one we know of to keep this usage off the load peaks; fourth, time control of energy use is an indispensable factor in meeting inexorable conditions.

Time control is employed by 78 per cent or more of the systems (estimated on a total customer basis) which have developed water heating by making commercially permissible rates. Water heating rates disregarding time control are not suitable for broad, general application because they are economically impossible; they can't be supported on a profit and loss basis; they cause customer distrust, are potential sources of rate agitations and a menace to good public relations.

The principle of time control is something distinct from the hours and methods of applying it. Individual company practices must vary according to widely different system necessities. E. N. Strait, manager of the B. E. & M. rate department, recently studied the controlled off-peak water heating rates of 105 companies operating in all sections of the United States. He found a wide divergence in their requirements and concluded that the majority had provided "too few safeguards" in their schedules for "the benefit and ultimate protection of the utility." Some of Mr. Strait's comments were as follows:

Hours of Operation—Of the 105 rate schedules studied, 23 specified no period of operation, merely generalizing to the extent of saying that operation must be during off-peak hours. Three other schedules contained a still more indefinite restriction, namely, that 85 per cent of the energy used by the water heater must be during off-peak hours. Six schedules provided for two periods of operation, one for general off-peak operation and one for less than ten hours daily operation. The alternative was used in limiting water wattage. Thus, 32 of the 105 schedules are very general as to the operating period allowed. The remaining 73 schedules show a very wide range in the allowable hours of operating, being summarized as follows:

Hours of Operation	Number of Schedules	Hours of Operation	Number of Schedules
7	1	14	4
8	23	15	7
8.5	1	16	4
9	2	17	3
10	8	18	0
11	..	19	4
12	4	20	2
13	..	..	..

While this table clearly shows an eight-hour operating period to predominate in the various rate schedules, it should also be noted that only 39 schedules limit operation to twelve hours or less. It would appear from the data that the utilities are about equally divided in favor of short- and long-hour off-peak operation. It is of interest in this connecton to note that of the 24 rate schedules added since May, 1935, only

four provided for more than ten hours of operation daily. The trend at present is strongly in favor of short-period operation, generally from 11 p.m. to 7 a.m.

Rate Levels—Practically all of the rates specified for this type of service are of the straight line type and are in fairly close conformity.

Number of Schedules	Rate Level Cents	Number of Schedules	Rate Level Cents
1	0.75	1	1.25
4	0.80	1	1.30
38	1.00	19	1.50
1	1.05	2	2.00
1	1.20		
		68	

In addition there are 37 other rates which are not strictly straight line rates, the majority of them being of the service charge type or containing a small block at a rate higher than that applicable to the major portion of the consumption.

Wattage Allowance per Gallon—Only 45 schedules specify the maximum wattage allowance per gallon of tank capacity for the storage unit and of these 27 specify a single maximum wattage. These specific limits vary considerably but tend to fix the wattage in most common use at from 20 to 25 watts per gallon.

Number of Schedules	Wattage	Number of Schedules	Wattage
8	20	1	35
4	22	2	50
5	25	2	60
3	30	1	100
1	33		
		27	

Of the remaining eighteen rates, six have two wattages specified, 20 watts per gallon for normal off-peak operation and 25 watts per gallon for less than ten hours operation off-peak. An additional group of three allow 25 watts per gallon where no mixing valves are attached and 37.5 watts per gallon where mixing valves are attached. One other is similar except that it specifies 20 and 25 watts per gallon respectively. Six schedules provide for capacities which vary with size of tank and one specifies combined maximum capacity of storage and booster unit. The final schedule provides for 20 watts per gallon for twin unit heaters and 25 watts per gallon for single unit heaters.

Only 31 schedules provide maximum wattage per gallon of the booster units. The majority of these (25) specify a single maximum.

Number of Schedules	Watts per Gallon	Number of Schedules	Watts per Gallon
12	30	5	50
4	33	1	100
1	35	1	143
1	40		
		25	

Three specify that the capacity shall not exceed 1½ times storage unit, one limits booster capacity to double storage, one specifies combined capacity of storage and booster unit and one provides 50 watts for plain heater and 30 watts for mixing heater.

Maximum Installation Size—Twenty-one schedules provide a total maximum capacity for the storage unit.

3 kw.—9 schedules
5 kw.—7 schedules
6 kw.—5 schedules

Eighteen schedules provide a maximum capacity for the booster unit

2 kw.— 5 schedules
3 kw.—10 schedules
5 kw.— 3 schedules

and one specifies the booster shall be twice the base unit.

Booster Unit on Regular Rates—Thirty-one schedules provide that booster consumption shall be billed upon regular rates. One schedule provides that when booster consumption exceeds 15 per cent of total water heating energy, the excess over 15 per cent shall be billed at 2.5 cents instead of 1.0 cent.

Simultaneous Operation of Storage and Booster Units—Only twenty schedules provide that the storage unit and booster unit shall not operate simultaneously.

Storage Tank—Thirty-six schedules provide that the storage tank and heater shall be approved by the utility and six provide that the tank shall be insulated.

Only ten schedules provide a minimum capacity for the storage tank.

24 gal.—1 schedule
30 gal.—7 schedules
50 gal.—2 schedules.

Realizing that details properly should conform to individual and local conditions, Mr. Strait thinks that a review of this data would suggest a degree of uniformity in rate schedules and requirements productive of good to the industry. There hardly can be much disagreement with his opinion from a sales department viewpoint. The greater simplicity and basic uniformity we can have the better for sales. While research and argument may go on behind the scenes, when things are put into the hands of a sales group they should be clear, definite and easy to understand; that is, if we expect sales results to be satisfactory. It isn't healthy to overemphasize unavoidable problems with the salesman looking on. He has a right to expect a degree of leadership that seems to know what it is doing.

Pertinent questions regarding time control fall in but two divisions: How to manage it so that the customer receives service which he regards as satisfactory and how to do it so as to keep the necessary investment as low as possible, and when I say "necessary investment" I mean the joint investment on the part of the customer and company. This little matter of investment has a most important influence on the number of customers who are going to use electric water heating, on the one hand, and how much the company will earn on the business, on the other. Water heating usually makes much faster progress when the company assumes all installation costs, except the cost of the heater itself. Irrespective of who pays for time controls, wiring and plumbing, both public and industry interest demand that these investment costs be made as low as possible consistent with safe and satisfactory service.

Methods of control

There seem to be but two feasible means of time control at present: By electric clocks mechanically operating circuit switches, and by carrier current, which means actuating the switch by brief impulses of high-frequency energy, transmitted from generating plant via transmission lines and substation over selective feeders of the distribution system to water heater customers.

With the rising volume of water heater sales has come a natural reduction in the cost of clock-control devices. Incidentally, I can't see how divergencies in charging periods have anything to do with the price of these devices. A comparatively recent development is combination of the clock, switch and meter into a single cased unit. This has meant a reduction of about $2 in a time unit which formerly had a factory cost to our larger companies of about $12—more recently about $10. Our engineers think they can see possibilities of getting the control unit alone down to about $5. Latest quantity quotation is $6.75. They say they can apply this saving at once if allowed to cut through the red tape and inertia surrounding some of the industry's operations. Our engineering departments are working closely with the sales departments toward cost reductions; some of the other departments are not so responsive. Headway is being made, nevertheless.

The introduction of a household wire circuit conveying current at a very low rate is a temptation to the dishonest minority covertly to hook on other appliances to that circuit. Some kind of protection is needed and certain companies have found it a serious matter. Our engineers first employed a circuit-breaking assembly, operating thermostatically in case of predetermined overload, costing about $7. They got it down to $3.50. Now they recommend a simple little affair—utilizing the fusetron — costing less than $1.50. I saw one the other day mounted with manually operated switch in a metal box priced with fusetrons at $1.35.

Service entrance assemblies, protective devices and meters represent investment carried by the company, regardless of who pays for the installation from this point on. Keeping down investment costs has gone up like a skyrocket in relative importance during the past few years. Many experiments and innovations have been undertaken. It is hard to find generally recognized standards.

Household service installations are now in a process of change toward

[*Continued on page 90*]

Distribution of Factory

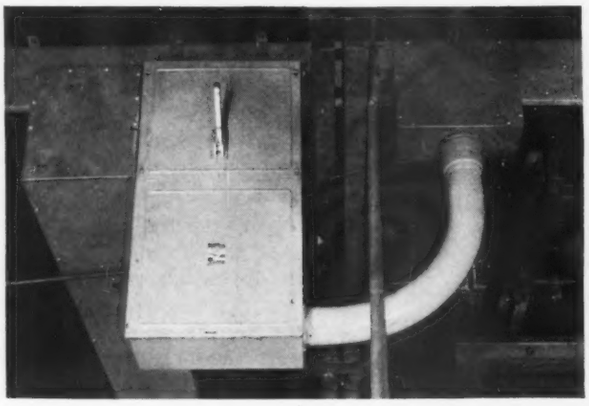
Power Distribution Cabinets Eliminated—Changes Henceforth Can Be Made as Easily as Plugging In

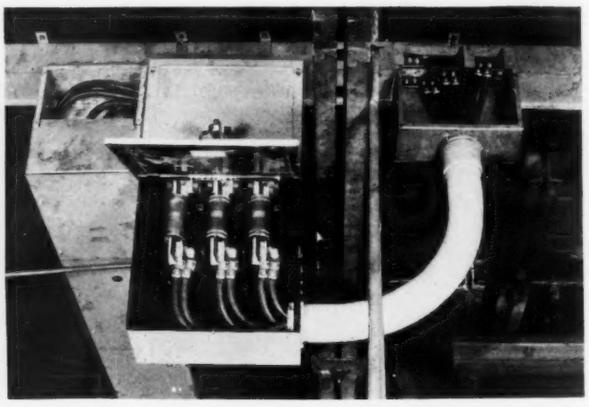
By R. M. WICKS
Electrical Engineer Illinois Tool Works, Chicago

ELECTRICAL ENGINEERS in industrial plants are continually confronted with the problem of keeping ahead of production by providing adequate electrical facilities. In these days methods of manufacturing and types of products are subject to rapid changes and the management is alert to place equipment in the most advantageous position so as to secure the greatest utility and output of plant and lowest costs per unit of product. The shifting of machines or the revamping of a department, and sometimes a complete rearrangement of equipment layout of the plant, is not an unusual move to be authorized by the production department. The brunt of the work is thrown on the electrical men, and while the task of tearing out conduits, changing panel boxes, ripping out old wire and pulling in new is not the hardest part of the job, there is the big question of determining the capacity of the power system for handling new equipment which is required by increase of business volume.

Changeovers and additions of equipment have to be accomplished in a minimum time so that lost production will not be too great, and in order to get the machines in operation quickly the electrician is required to plan the work in careful detail. The best plan will contain difficulties, because usually new material has to be ordered and often there are some essential things that are missing because their necessity appears only after the job has been started.

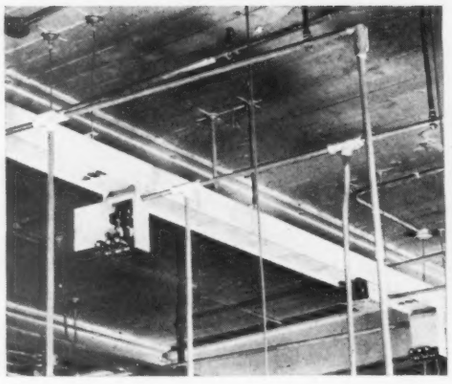
The Illinois Tool Works produces milling cutters, broaches, shaper cutters, hobs and various special production tools. These products must be held to extreme accuracies. In the plant we have a division that manufactures the "Shakeproof" lock washer, which is of considerably different production methods from those of

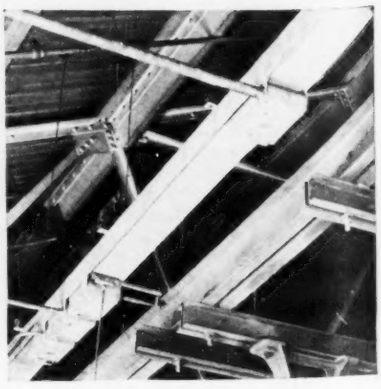




Fused switches at bus connections

At the left in both pictures is the run of bus-way from the switch room. Connection to the backbone bus running through the plant is through the switch shown. The switch is operable from the floor by a stick. The same arrangement is used at the points where the "Flex-A-Power" branches tap off from the backbone bus.

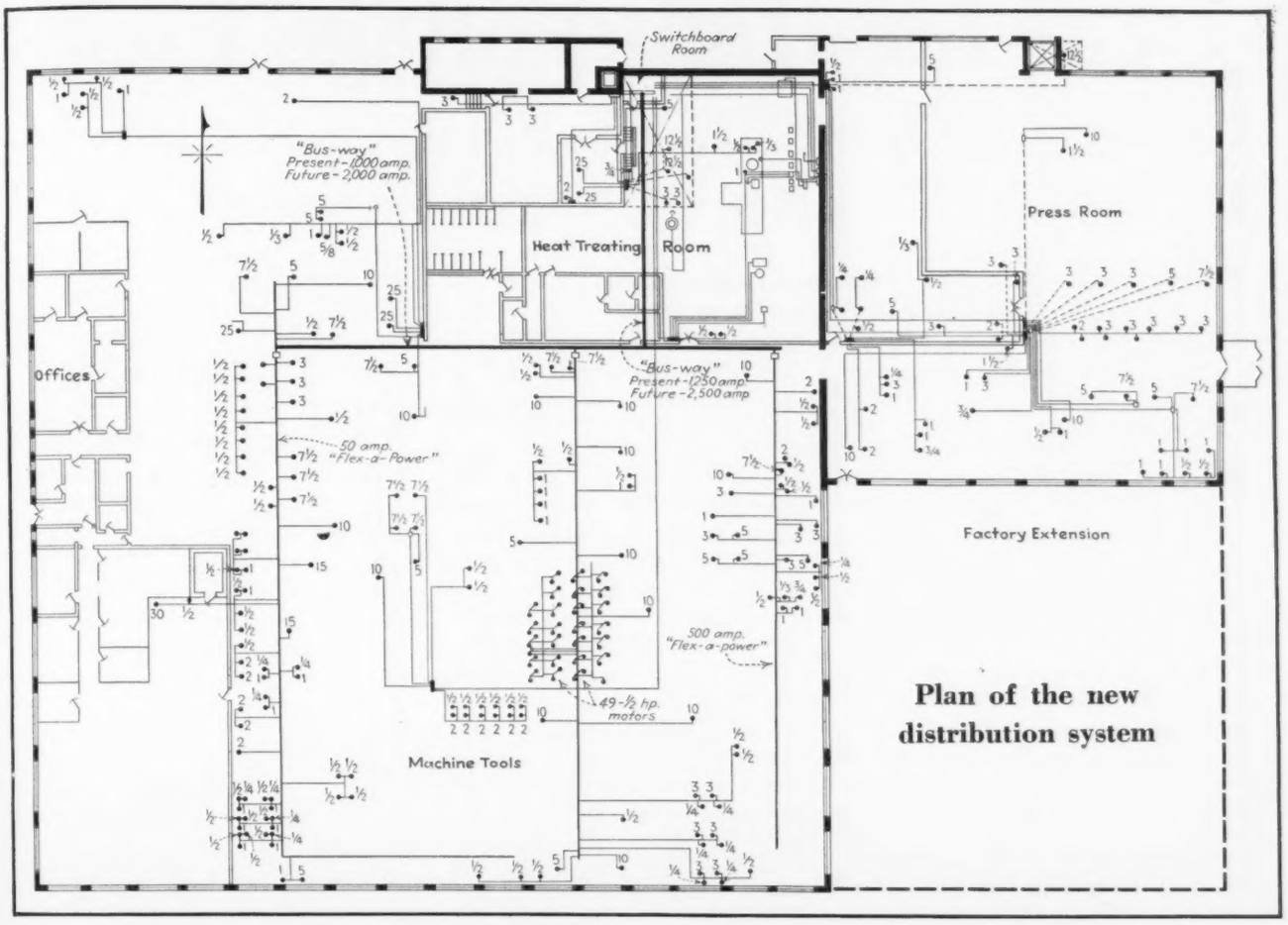




Tap off anywhere

These two pictures show taps from the "Flex-A-Power" lines. The fused tap boxes, which may be installed on 1-ft. spacings, are hinged on the axis of the conduit running to the load. Projecting from the box are three insulated contact members whose jaws clamp on the flat copper bus in the duct when the box is moved up into horizontal position. Thus there is no access to the fuses unless the block is dead.

Power Made Flexible



Plan of the new distribution system

From the switchboard room runs an inclosed bus of 1,250 amp. capacity which can be doubled by adding bars. This is connected at what will be about the midpoint of another bus running along the main axis of the plant. "Flex-A-Power" branches take off at three points from this bus and machine motor connections are made whenever necessary from these branches. Other branches can be tapped off at the points indicated, and if voltage regulation requires in the future the branches may be tied together at the far ends. The cabinets and conduit runs therefrom are survivals from the previous wiring system to be, or already, replaced by the new distribution. The job is being done with the minimum disturbance of production and pretty much as changes in production facilities make it advantageous. The electric furnaces in the heat-treating room will not be included in the new system, but will take their supply direct from the main switchboard, utilizing positions previously occupied by distribution feeders.

high-speed metal-cutting tools. Both of these products are continually changing because of new developments which quite frequently require equipment changes on relatively short notice.

System provides flexibility

This is why the electrical supply system has to be adaptable to future expansion and improvement programs. It explains why the "Flex-A-Power" system was adopted, because it was recognized to have flexibility to meet the demands of the future in a more economical way than ordinary pipe and wire systems.

Having a group of machines tied up with one line shaft and motor is challenged by the idea of individual drives, and particularly in the kind of manufacturing we are engaged in it is very inefficient because the service required on production tools demands that we operate individual machines at any time during the day and night. The installation of "Flex-A-Power" provides convenient points to plug in machine connections and it has eliminated much costly change-over work when demands for changes occur. It also provides capacity for the future and it is expected to pay dividends by eliminating much of the work that usually attends changes in the electrical set-up.

The diagram shows the start of the job and the manner in which it is being carried out, but does not include all the work that has been done to date. If the complete layout were shown the procedure for the change-over would not be apparent in the drawing. After the installation is complete there will be no power distribution cabinets in the plant and new equipment can be installed and old machines moved without much more electrical work than is necessary in plugging in a lamp cord in a socket.

Time Current Curves for High-Voltage Fuses

Two Sets of Fuse Curves Will Meet Most Requirements of Co-ordination With Relays and Breakers

Working knowledge of the fundamentals of high-voltage fuse time-current characteristics is an instrument which may be readily used to improve system protection. The modern fuse application necessitates the co-ordination of the fuse with other system protective devices. For this reason the fuse time-current characteristic is of major importance.

By E. A. WILLIAMS
Switchgear Engineering Department, General Electric Company, Philadelphia

TIME-CURRENT characteristics of high-voltage fuses expressed in the form of curves are of two general types: (1) Melting time curves, which give the relation between current and the time required to melt the fuse link; (2) total clearing time curves, which give the relation between current and the time required for the fuse to interrupt the circuit. These two types of curves are equally important and each has a specific function in the proper application of high-voltage fuses.

It is desirable that the shape of the time-current curve be selected to provide the maximum system protection. Realization of this ideal is a joint responsibility of the manufacturer and the user of fuses. The manufacturer must provide fuses with accurate curves of the best possible shape and the user must select fuses which can be best co-ordinated with the other equipment on his system. A fuse cannot be selected on the basis of its voltage and ampere rating alone as there are an infinite number of possible curves for the same rating.

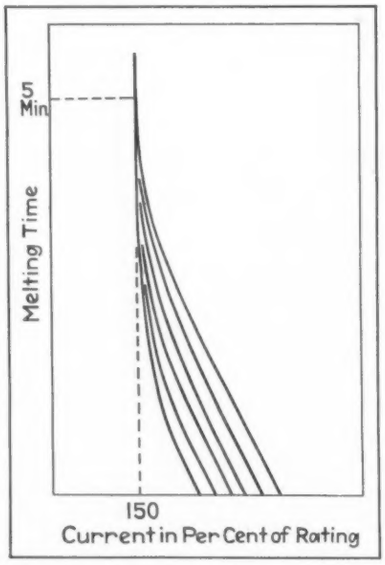


Fig. 1—Fuses can have same I and E ratings, but various time-current characteristics

The first step in designing time-current curves is to make a study of the other equipment with which the fuse must be co-ordinated. The study, if properly made, will result in a "desired" fuse curve for the application under consideration and it is then the responsibility of the designer to produce a fuse whose time-current curve will conform as nearly as possible to the ideal.

To provide a definite working basis for a discussion of time-current curves it will be assumed that all fuses starting at a temperature of 20 deg. C. will melt at 150 per cent of rated current (230 per cent of maximum continuous current) in exactly five minutes. This assumption immediately fixes one point on the melting curve. The selection of this point is purely arbitrary, within the limits of N.E.M.A. standards, but must always be made if a comparison between the shape of two curves is to be of maximum value. It is possible for an infinite number of curves to pass through this one point (Fig. 1).

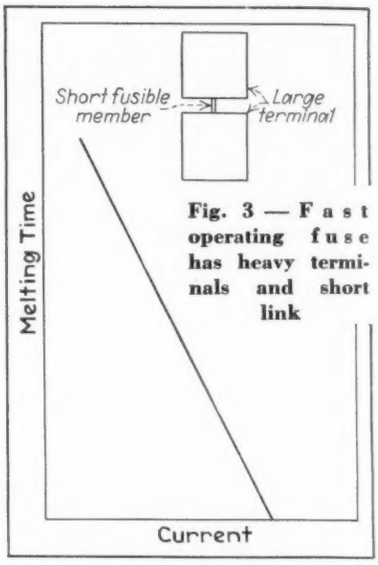


Fig. 3 — Fast operating fuse has heavy terminals and short link

Fig. 2—With no heat loss time-current curve (on log-log plot) is a straight line

Shape of a melting time-current curve is governed by simple physical laws. The passage of current through the fusible member of a given fuse link generates heat which is directly proportional to the square of the r.m.s. current and to the time of current application. If all heat is kept in the fusible member—that is, if none of the heat is dissipated—the equation of the melting time-current curve is:

$$I^2t = k$$

where

I = Current in r.m.s. amperes
t = Time to melt in seconds
k = Constant, depending upon the physical characteristics of the fusible member.

The above equation plotted on log log paper results in a straight line with a slope of 2 to 1, as shown by

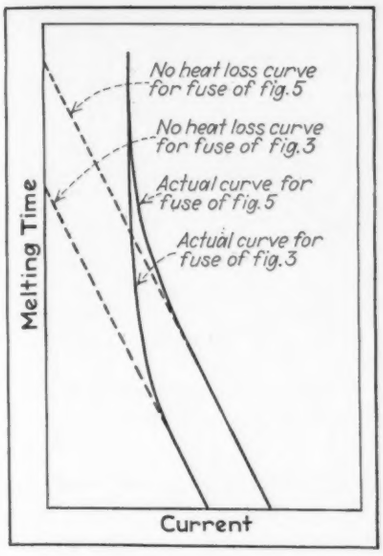

No heat loss curve for fuse of fig.5
No heat loss curve for fuse of fig.3
Actual curve for fuse of fig.5
Actual curve for fuse of fig.3
Melting Time
Current

Fig. 4—Heat loss lengthens melting time

Fig. 2. Obviously, such a fuse cannot exist as it is impossible to prevent the loss of heat from the fusible member. However, the hypothetical case will be used as a basis to show how the shape of the melting time-current curve may be controlled by selection of the physical characteristics of the fusible member and the size and shape of its terminals.

A short fusible member of small cross-section connected between two large terminals, as in Fig. 3, has a relatively high continuous current rating due to the fact that the large terminals rapidly conduct the normally generated heat away from the fusible member. Under short-circuit conditions the fusible member, due to its small area of cross-section, will melt before the heat can be absorbed by the terminals and an exceedingly "fast" fuse results. The relation between the actual curve and the curve which would have resulted if no heat was lost is illustrated in Fig. 4.

A long fusible member connected between two relatively small terminals, as in Fig. 5, requires a much greater area of cross-sectional to carry the same continuous current as the fuse of Fig. 3. This condition is true by virtue of the fact that the small terminals have practically no effect upon the temperature at the center of the long fusible member. However, under short-circuit conditions the relatively large fusible section must be heated to the melting temperature and an exceedingly "slow" fuse results. The relation between this actual curve and the curve which would have resulted if no heat was lost is also illustrated in Fig. 4.

It is reasonable to assume that extremely high currents will melt a fuse before any appreciable amount of heat can be lost. Therefore, at all currents above a certain magnitude the time-current curve, plotted on log log paper, should be a straight line

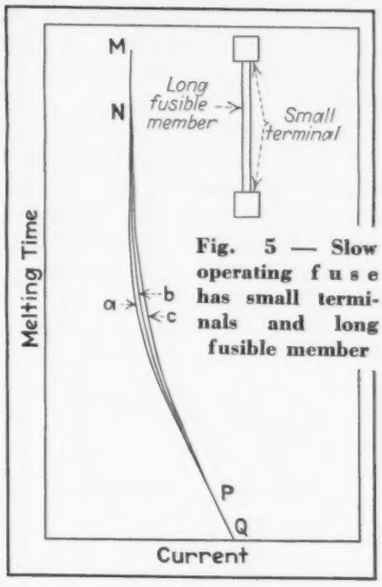


Fig. 5 — Slow operating fuse has small terminals and long fusible member

Fig. 6—Knee variations effected by design proportions

Assume that the proper proportions of terminal size, section area and length of fusible member have been selected to produce the desired location of the straight line sections, *MN* and *PQ*, of the curve. Upon plotting the full curve it is found that the knee coincides with curve b of Fig. 6. An increase in the length of the fusible member and a proportional increase in the size of terminals will shift the curve from b to c, or a decrease in the length of the fusible member and a proportional decrease in the size of terminals will shift the curve from b to a. Thus the knee may be shifted to any position between a and c without disturbing the straight line portions of the curve.

having the equation $I^2t = k$. Actual tests with the fuse link in air prove this assumption to be sufficiently correct for all practical purposes. The straight line portion of the time-current curve is shown between *P* and *Q* of Fig. 6. With a given fuse link material, the location of this straight portion of the curve is completely determined by the cross-sectional area of the fusible member.

At the opposite end of the current range there is a certain critical current which, theoretically, will produce just the right amount of heat to bring the fusible member to the melting temperature, but will not produce sufficient heat to supply the energy necessary to fuse the metal. Under this condition the heat generated is equal to the heat dissipated and the fuse operates indefinitely at its melting temperature. Actually, this unstable condition cannot exist in practice due to the fact that a slight change in current produces a major change in melting time. The resultant curve in this range is, therefore, a vertical straight line as shown between

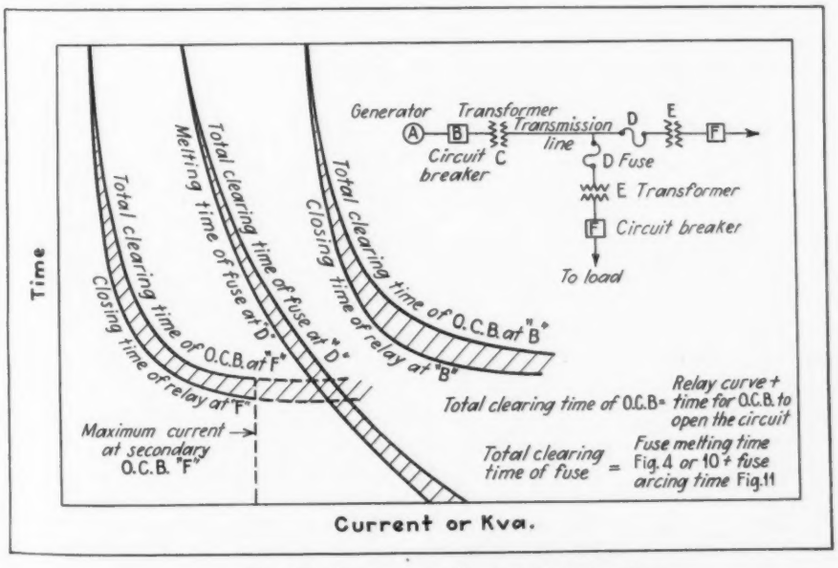


Fig. 7—Fuses co-ordinated with breakers

A properly selected fuse at *D* (Fig. 7) will provide back-up protection for the feeder breaker, *F*, and will prevent a transmission line outage on faults occurring at the transformer, *E*, or between the transformer and the feeder breaker. However, to provide this complete protection the fuse must be of a certain rating and its curve must be so selected that upon the occurrence of a distribution line fault (beyond breaker *F*) the breaker, *F*, will always *interrupt* the circuit before the fuse melts. Also, upon the occurrence of a primary or secondary fault at transformer, *E*, the fuse will *interrupt* the circuit before the relay at *B* closes its contacts.

M and *N*, Fig. 6. Its location is determined by the cross-section and length of the fusible member and by the size and proximity of the adjacent terminals.

A melting time-current curve, plotted on log log paper, consists of two straight lines and a curve connecting the two. The connecting curve is commonly known as the "knee" and its various forms are indicated in Fig. 6, curves a, b and c.

Adjusting the size of terminals and length of fusible member in the proper proportions merely changes the rate of heat dissipation at the knee of the curve. However, the amount of variation obtainable at the knee of the curve is relatively small and is of little importance in practical designs.

Reliable operating characteristics of high-voltage power fuses make it possible to apply them on many transmission systems and in many important locations on these systems. The fuse is not a "piece of wire" which functions only on heavy short-circuit currents, but is a device capable of being co-ordinated with relays and other protective devices on the system. A typical application is illustrated in Fig. 7.

To definitely obtain the proper selective action between fuse and circuit breakers it is necessary to plot the curves of all devices involved as shown in Fig. 7. The checking of two or three points on the curves is insufficient as variation in fault impedance and variation in the shapes

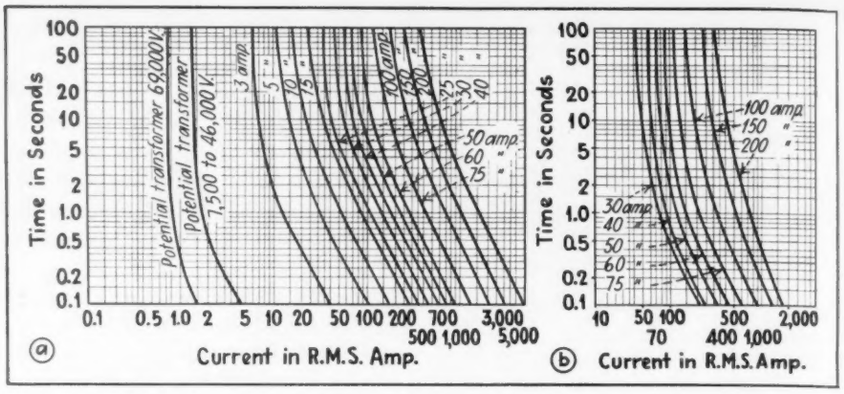


Fig. 9—Melting time-current characteristic curves of G. E. outdoor high-voltage fuse units—(a) Standard type. (b) Fast operating

of the curves make it advisable to check the complete range of fault currents. The composite relay and breaker curves should always be compared with the composite melting and total clearing time curve of the fuse as the use of these composite curves is the only means of obtaining the true total operating time of the devices involved. The data required properly to co-ordinate high-voltage fuses and circuit breakers are, therefore, (1) relay curves; (2) breaker operating time, exclusive of relay; (3) fuse melting time curves, and (4) fuse arcing time curves. Most reliable manufacturers either publish these required data or will supply them on request.

Even with all necessary co-ordination data available it is not always possible to obtain the desired selectivity between all fuses and relays. This unfortunate condition is due to the fact that there are many types of relays and most of them are provided with a means of adjusting the time of operation. As an example, one line of induction type overcurrent relays has adjustable time lever settings which produce the variety of curves shown in Fig. 8. A study of the shapes of these relay curves clearly shows that a fuse curve designed for co-ordination with No. 1 relay curve could not possibly provide the most efficient co-ordination with the No. 10 relay curve. It must therefore be concluded that fuses having a variety of curves are necessary for the best co-ordination with induction overcurrent relays.

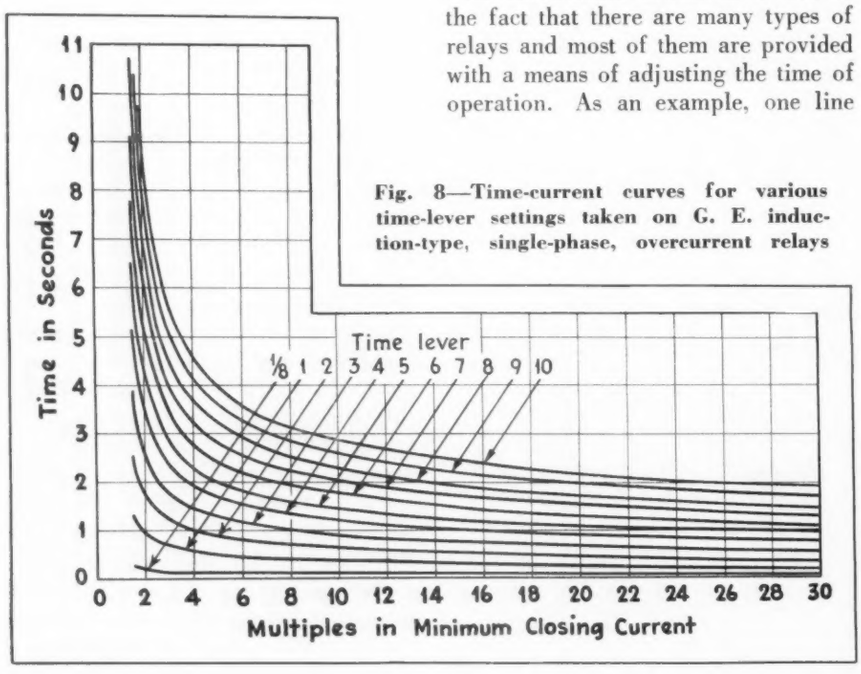


Fig. 8—Time-current curves for various time-lever settings taken on G. E. induction-type, single-phase, overcurrent relays

Since the maximum and minimum time lever settings of the relay are seldom used and since fuse and relay curves cannot be designed to have the same identical shape, a practical analysis of the requirements indicates that two sets of fuse curves will take care of almost all co-ordination requirements. The fuse curves shown in Fig. 9a are designed for close co-ordination with induction overcurrent relays having the average time lever settings in use throughout the country today. The fuse curves shown in Fig. 9b are designed for close co-ordination with induction overcurrent relays having extremely low (fast operating) time lever settings. Fuse curves even slower than those shown in Fig. 9a are desirable for close co-ordination with relays having extremely high (slow operating) time lever settings, but because of the trend toward faster relaying the slow operating fuses are seldom required.

The advantages of a choice between two fuses having the same current rating but different time-current curves may be illustrated by comparing the melting time of the "standard" fuse of Fig. 9a and the "fast operating" fuse of Fig. 9b. The 75-amp. "standard" fuse requires 0.7 second to

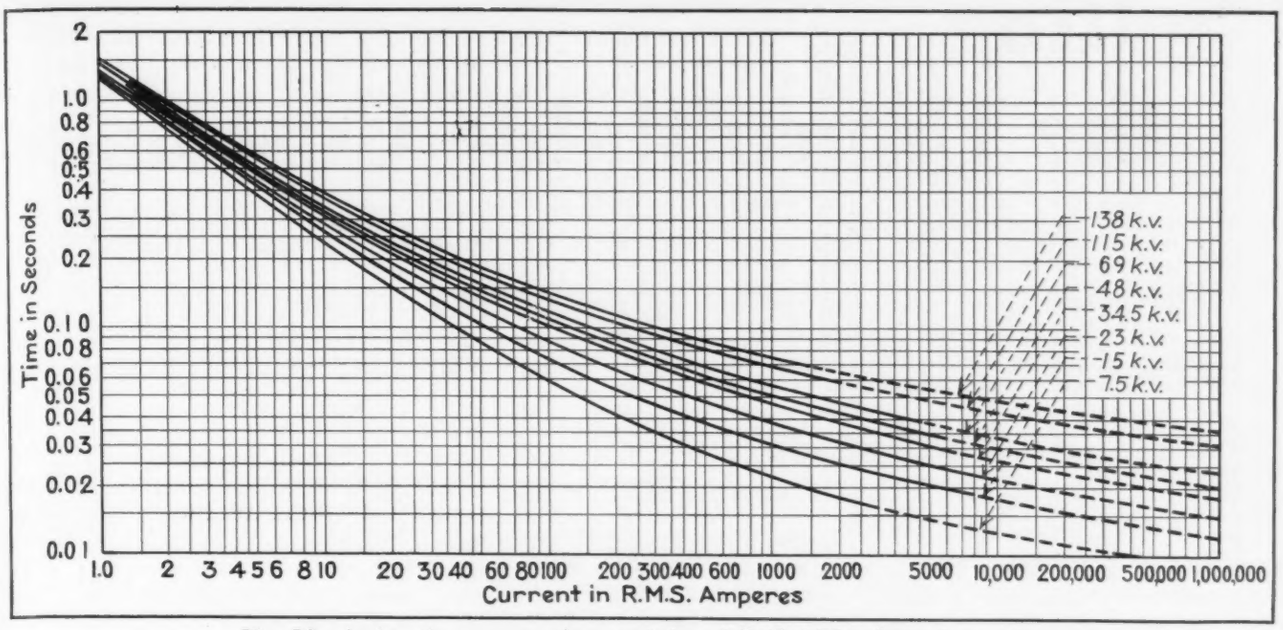


Fig. 10—Arcing time-current characteristics of G. E. high-voltage fuse units

melt at a current of 500 amp., while the "fast operating" fuse requires only 0.15 second to melt at the same current. Each of these fuses will carry the same continuous current.

High-voltage power fuses are manufactured in standard voltage ratings of 7,500 volts to 138,000 volts and in standard current ratings from ½ amp. to 400 amp. This great variety of ratings makes it necessary to take some short cuts in publishing time-current curve data. The use of log log paper allows the melting time curves of a complete line of fuses to be plotted on a single sheet. Nine such sheets would be required to publish total interrupting time curves for the same line of fuses. The use of arcing time curves as shown in Fig. 10 eliminates eight sets of curves and allows data equivalent to complete melting and total clearing time curves to be plotted as two sets of curves. The total clearing time for any given condition may be easily obtained by adding the arcing time from Fig. 10 to the melting time from Fig. 9a or Fig. 9b.

In some applications involving extremely close co-ordination the effect of variations in initial load current and in ambient temperature should be taken into account. These variations have no appreciable effect upon the arcing time curve. The melting time curve of Fig. 9 may be compensated for initial load current and ambient temperatures by the use of the correction factor given in Fig. 11. In general, the margin between two co-ordinated devices is sufficiently great to make this correction unnecessary, but it is always advisable to check this point when unusually close co-ordination is desired.

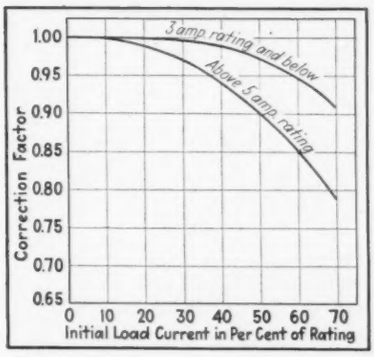


Fig. 11—Correction factors for initial load current and ambient temperature

1. The time required to melt the fuse link at any given current (see time-current characteristic curves) should be multiplied by the correction factor as determined by the initial load current and ambient temperature.
2. Curves apply at ambient temperatures of 20 to 25 deg. C.
3. For each 10 deg. C. increase in ambient temperature subtract 2.5 per cent from correction factor shown.
4. For each 10 deg. C. decrease in ambient temperature add 2.5 per cent to correction factor shown.

Conclusions

1. Fuses must be designed to have time-current characteristics which will co-ordinate with other protective devices on the electrical system. This requirement is largely dictated by established relay practices.

2. Shape of the lower portion of the time-current curve with the fuse link in air is dependent upon the simple physical law $I^2t=k$. This gives a straight line curve, with a slope of 2 to 1, when plotted on log log paper.

3. Shape of the upper portion of the time-current curve is dependent upon the length of the fuse link and the heat-dissipating ability of the fuse terminals and the surrounding medium.

4. Time-current curves of high-voltage fuses are so numerous that it is not practical for manufacturers to publish all of them. Ordinarily two sets of high-voltage fuses, each with its own set of time-current characteristics (one standard and one fast), are necessary to co-ordinate with existing relays.

5. Since high-voltage fuses rated 15 kv. and above cover such a wide range of voltages, a separate arcing time curve, based on tests at rated voltage, is required for each voltage rating.

6. To insure the proper co-ordination of high-voltage fuses the time-current characteristics of all protective devices involved should be plotted on the same sheet to the same scale.

7. The data required properly to co-ordinate high-voltage fuses and circuit breakers are: (1) Relay curves; (2) breaker operating time, exclusive of relay; (3) fuse melting time curves, and (4) fuse arcing time curves.

8. In applications requiring unusually close co-ordination correction should be made for ambient temperature and initial load current.

Selling the Unprofitable Customer

Facts and Figures Show Advantages of an Intensive Campaign, Directed Upon the Low-Use, Low-Income Customer, After the Company Knows Who He Is, What He Is, His Likes and Dislikes

By AUSTIN MONTY
Manager of Merchandise Sales
Philadelphia Electric Company

In a preceding issue Mr. Monty told of a market analysis of the unprofitable customers. This is a crisp recital of selling results obtained in the same market.

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SOME time ago Philadelphia Electric decided to obtain some intimate knowledge of its large group of unprofitable customers through an extensive survey. Market analysis of this kind, if properly done, is an expensive undertaking, consequently the activity was set up on the basis of sales and survey combined, designed to produce revenue and be as self-supporting as possible.

Accordingly a group of 22 men, consisting of a supervisor and ten men each, was organized and carefully trained to call only on customers using 400 kw.-hr. or less. In addition to securing information on the social and economic status of these customers and determining the electrical appliances in use, the survey men were required to sell certain appliances which were selected because of low first cost and high energy use. The appliances were:

1. Pin-it-up lamp.
2. Low-priced non-automatic iron.
3. Medium-priced automatic iron.
4. Low-priced non-automatic toaster.
5. Low-priced percolator.
6. Waffle iron.
7. Table stove.

By actual field test it was determined that an average man could make 25 surveys and average two sales per day. Accordingly, this was set up as a minimum requirement which the men had to meet to hold their jobs. The major part of the compensation of this group is salary augmented by a sliding scale of small bonuses based on sales production. As the work progressed, refrigerators restricted to 3 and 4 cu. ft. capacity, a small radio, and more recently a washer, were added.

Contrary to our expectation, we found that this type of customer prefers overwhelmingly the automatic iron. Four times as many automatic as non-automatic were sold. The 3 or 4-cu. ft. refrigerator could not be sold because of inadequacy, because the poorer class of customers have large families. Radios were added chiefly to replace battery sets. Washers were added too recently to be reported in this paper.

Radios, refrigerators or washers are subject to credit investigation and approval, but in so far as the original list of small appliances is concerned, no credit approval is required.

Naturally, having decided to sell small appliances to the poorer class of customers, without credit approval, this phase of the activity was watched very closely. An analysis of 7,804 accounts after eight months shows that of the total amount of $28,676.54 sold on installment $24,810.81 had been paid; $3,865.75, or 13.5 per cent, was outstanding; $1,012.51, or 3.8 per cent, was delinquent, and $211.09, or 0.73 per cent, was charged off as uncollectible.

This is an excellent record and seems to show that the poorer class of customer is not inclined to overbuy and has a strong sense of responsibility toward his financial obligations. Contrary to the opinion of finance companies, our experience seems to indicate that small monthly payments are met more promptly than the larger ones, with consequent reduction of collection expenses and losses.

Among unprofitable customers we find a high degree of acceptance for refrigerators and washers. They are perfectly satisfied with the operating cost of these devices, but are unable to afford monthly installments necessary to purchase the equipment. For example, nearly 20,000 unprofitable customers expressed the desire to possess a washer. The operating cost of a washing machine is only about 8 cents per month, which these families could well afford. The difficulty is that they are unable to meet the monthly installments necessary to purchase the equipment. In Philadelphia the lowest terms available for this appliance call for an outlay 52 times the monthly operating cost.

Some of the more important statistics which have been compiled are rather interesting and the tables are practically self-explanatory. Table

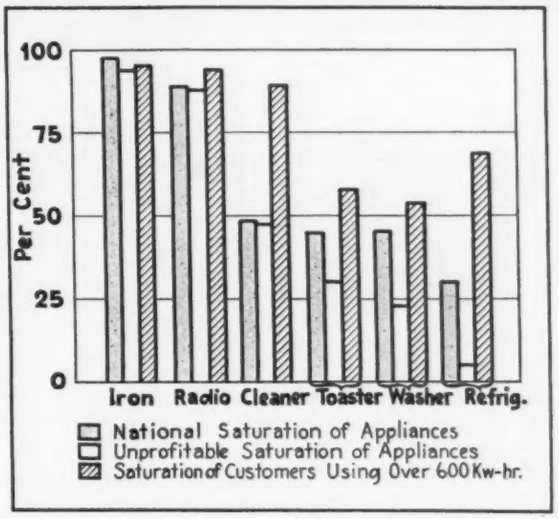
I shows the number of cails made, the number of interviews secured and the percentage of sales to interviews. The men were able to sell 11.5 per cent of the customers interviewed, indicating the effectiveness of sales effort.

The appliances in use in the homes of unprofitable customers, as shown in Table II, is illuminating. The radio, for example, enjoys a very high saturation, probably because it is the cheapest form of entertainment for the family, and it may be the only amusement which these people can afford.

The cleaner saturation is surprising. It must be noted, however, that the 60,000 cleaners include a substantial number of hand cleaners and cheap rebuilt machines available at a low first cost.

The washer saturation is significant. The survey men inform us that the great number of these people still use the washboard.

The chart is perhaps the most interesting. It is a comparison of the national saturation of appliances with that of the unprofitable customer and the saturation among those Philadelphia customers using more than 600 kw.-hr. Ranges and water heaters are not shown, for there is no question as to where they are being sold.



Exposure of saturation fallacy

This chart presents a more accurate picture of appliance saturation than the usual average figures for all customers. For example, the statement that the refrigeration saturation in Philadelphia is 35 per cent does not tell us that 70 per cent of the available market has been sold, because we know that unless the financial condition of more than 50 per cent of our customers improves materially, we have sold 70 per cent of the possible market. In addition, this chart shows conclusively where the load-building job is being done.

Table I—Unprofitable Customers

Calls made	168,195
Interviews	128,903
Ratio of interviews to calls	76.6
Ratio of sales to interviews, per cent	11.52

Table II—Appliance usage among unprofitable customers

Appliances in use	Units	Per Cent	Appliances in use	Units	Per Cent
Iron	121,164	94.0	P'rcolat'r	8,130	6.3
Radio	113,448	88.0	Refrigerator	6,823	5.3
Cleaner	60,680	47.1	Space heater	1,217	0.9
Toaster	39,643	30.8	Ironer	210	0.2
Washer	29,122	22.6			
Clock	15,694	12.2			
Waffle Iron	10,292	8.0			

Table III—Appliances sold to unprofitable customers

Sold by Survey Men

Portable lamps	10,560	Refrigerators	77
Irons	3,355	Waffle irons	43
Radios	662	Percolators	7
Toasters	155	Table stoves	2

Sold From Survey Men's Leads

Washers	93	Small appliances	16
Radios	88	Ranges	7
Refrigerators	54	Ironers	2
Cleaners	25	Water heaters	1

Total Sales 15,147

Appliances	Avg. Increase in Kw.-hr. per Month	Avg. Increase in Revenue per Month	Est. Avg. Annual Inc. in Revenue
Lamp	4.1	$0.22	$2.64
Iron	3.7	0.20	2.40
Radio	4.7	0.26	3.12

Estimated annual revenue secured from survey sales	$41,133.25
Estimated annual revenue secured from survey leads	2,636.29
Total estimated annual revenue	$43,769.54

Table IV—What the unprofitable customer will purchase next

Refrigerators	29,531	40.9	Toasters	848	1.2
Washers	19,807	27.4	Miscellaneous appliances	1,197	1.7
Cleaners	8,380	11.6			
Radios	8,227	11.4			
Irons	2,434	3.4			
Portable lamps	938	1.3	Number of customers	72,190	
Ranges	828	1.1			

Results and costs

Table III presents rather briefly the sales results obtained by the survey men to date. The first tabulation shows the appliances sold directly by the survey men.

Appliances sold from the leads turned in by the survey men are shown here also. The men were not permitted to sell any appliances except those specifically assigned to them. Prospects for other merchandise were turned over to the regular sales force.

The actual increase in energy consumption due to the appliances sold is given in Table III. These figures are actual and not estimated. Energy consumption was determined by checking a large number of accounts and comparing the energy used for a period of four months after the purchase of the appliance with the energy used in the corresponding four months in the previous year. The great value of the pin-it-up lamp is very evident. The last figure of $43,769 is the annual revenue produced by the work of these survey men. The cost to us is about $1,000 per month. This sum represents the merchandise loss. If we divide the cost by the revenue we arrive at a figure of 61 cents per dollar of increased revenue. The costs are actual and are not figured on an increment basis. It would seem that from a financial standpoint the work has been fairly successful. The cost of the additional kilowatt-hours sold amounts to very little more than the cost of generation.

The next purchase

Unprofitable customers were asked which appliance they intended to buy next. A specific answer was obtained from 56 per cent of these customers. The compilation of this information is shown in Table IV and is rather illuminating. It is apparent that a substantial number of appliances could be sold if the financial condition of this group would permit, or if the monthly installments could be brought within their reach. The operating cost is no barrier to the acquisition of appliances. In the case of refrigerators, it would appear at first sight that there does not exist as great a disproportion between the operating cost and the monthly installment as is the case with washers. However, our investigation in the field among those unprofitable customers who possess this appliance shows that a refrigerator is used only in the hot months, thus yielding a yearly revenue of about $9 or $10. It is this sum which should be compared with installments aggregating $80 or $90 in a year.

Wired Radio Controls Galvanizing Process

Off-Peak Operation Automatically Governed on Substation Feeder

By E. M. BRYDON . . . A. M. TROGNER
Canadian Line Materials, Ltd. Wired Radio of Canada, Ltd.

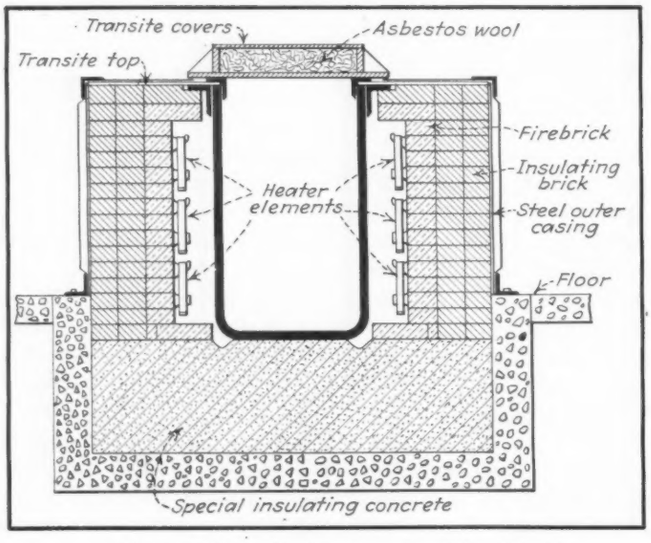
TO ACHIEVE the advantages of electric heating in galvanizing a wide range of products manufactured by our affiliate, Canadian Line Materials, Ltd., automatic control of off-peak purchased power service was necessary. We had previously operated a hot dip kettle by oil burners, but a study of electric heating indicated that we could expect a more uniform grade of product, better control of metal temperature, increased kettle life, much less dross formation, increased production and improved working conditions for operators by this means. The economic and technical problems were solved by designing a kettle especially adapted to the production requirements and utilizing wired radio control to keep the outfit off the power system peak.

The thermal design provides for keeping all losses at a minimum, especially during on-peak periods when power is not available. It is not within the scope of this article to describe the details of the thermal design except to say that we endeavored to make maximum use of the most recent improvements in thermal insulation. A study of previous operating records led to the adoption of 83,000 lb. per month as average production with 220 hours operating and 500 hours standby. The maximum hourly production of 600 lb. on a sustained basis was also set. Material handled varied from bolts and washers weighing 1 or 2 oz. up to long crossarms, etc., up to 100 lb. This wide variation required a kettle size rather large in comparison with the annual output of galvanized material. The dimensions determined were 22 in. width, 9 ft. length and 40 in. depth. The top surface size was selected as that which would handle the material and still keep the radiating surface at a minimum. Even with this area calculations showed that one-half of the total power required per month would be lost as radiation from this surface during the 220 hours per month.

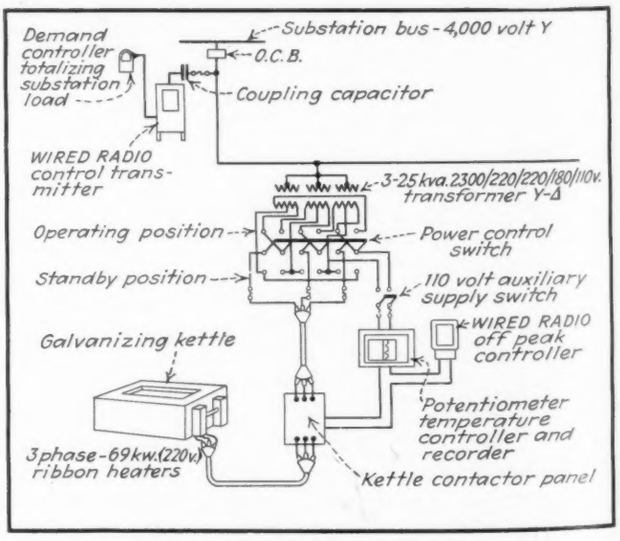
While studies showed that a 46-kw. heater would suffice to handle 600 lb. per hour production, additional capacity for future growth was provided. Transformers were installed with secondaries tapped to deliver 69 kw. at 220 volts, 57 kw. at 200, 46 at 180 volts and about 17.5 kw. at 110 volts. The 110-volt taps are for night and standby use only, when the kettle is not in operation and when the insulating covers are on. Ribbon type heaters were used as these cost less than the immersion type.

The zinc bath temperature control is obtained through a potentiometer recorder and controller connected to two pyrometers, one in the zinc and one in the heater space just outside the kettle. The pyrometer in the zinc is set to keep the bath temperature within 5 deg. of 860 F., and the one in the heating chamber is set to cut off the heaters at about 975 deg. to prevent overheating in case the first pyrometer should not function. Both temperatures are continuously recorded on a month's strip record, which has proved very valuable under the varying conditions of operation.

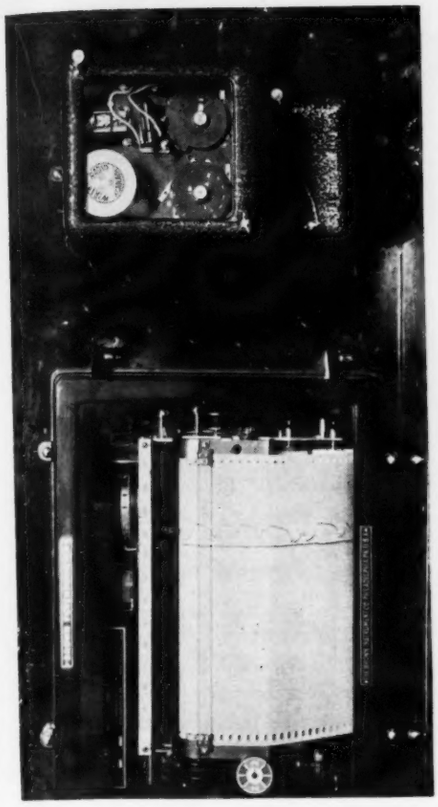
Our calculations showed that maxi-



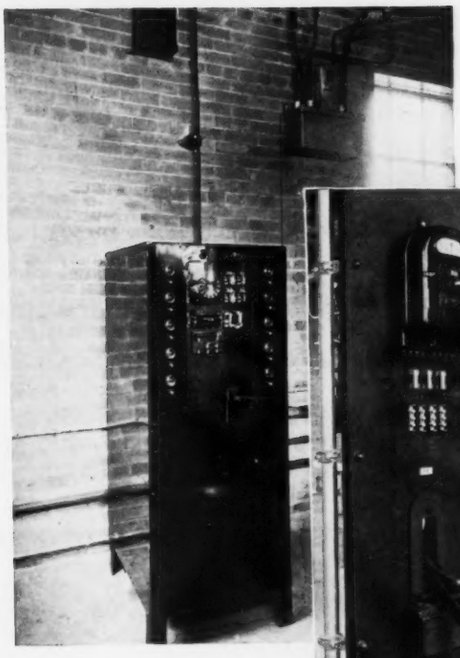
Cross-section of electric galvanizing kettle



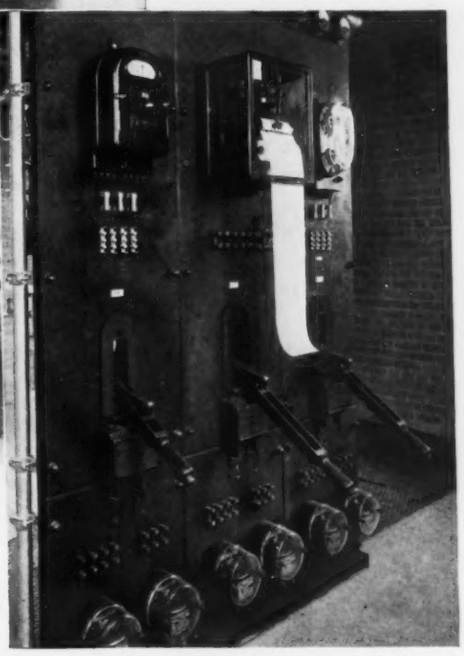
Wiring scheme for wired radio control of kettle



Control equipment at galvanizing plant



Wired radio transmitter in substation of power system



Demand controller equipment at substation

Galvanizing tank in service

mum efficiency would be had by maintaining the kettle temperature at a constant fixed value. This meant that off-peak periods of no available power must be reduced to the minimum time. Since the power substation peak is variable in time and duration, clock control would be uneconomical, and a type of control was necessary which would cut the kettle off when the substation load required it. To provide this, a wired radio transmitter was installed in the substation with a station load totalizing demand controller to initiate its operation. At the galvanizing kettle, about 0.75 mile away, a control unit was installed with its contactor in series with the temperature control of its circuit. When the pointer on the demand controller in the substation reaches a predetermined level the wired radio control transmitter is automatically started up. It sends an "off" signal over the power feeder to our plant and then shuts down. This signal operates the control unit to open the kettle contactor circuit, thus cutting off the power supply from the kettle.

When the substation load drops again to the pre-set value the transmitter again starts up, sends an "on" signal to the plant and then shuts down. This "on" signal operates the control unit to close the kettle contactor circuit, allowing it to turn on the heater elements and bring the zinc temperature back to normal.

The inherent time delay of the demand controller prevents hunting and the transmitter operations are positive and definite. Since the substation is unattended the entire operation is automatic. The demand controller is adjusted periodically to operate at a load value which experience shows is below the expected peaks. The control unit at the kettle is connected to the 110-volt tap of one of the kettle transformers. This connection supplies both power for its operation and a path for the wired radio control signals. At the substation the transmitter is coupled to the 4-kv. feeder through a 2-mfd. capacitor and fuse cutout.

Results of service

While electrically heated galvanizing is not new, we believe this is the first installation using off-peak power with automatic off-peak control actuated by the rise and fall of the substation load. We find this to be a reliable method of keeping the kettle

[*Continued on page 92*]

Utilities Near All-Time Record

November revenue rises 8.1 per cent, energy sales 15.5 per cent, steam plants carrying the added load.

FOLLOWING the record-breaking output of energy for electric light and power in October, revenue rose in November to a new top for that month, close to the all-time high. The amount received from ultimate consumers was $183,065,600, as reported by the Edison Electric Institute, surpassing last year's figure for the like period by 8.1 per cent. This increase was somewhat smaller than in other recent months, for the rate has on several occasions gone above 10 per cent, but healthy growth continues. In line with the usual seasonal movement there was a gain of 2 per cent over the preceding month.

Progress over 1935 was strongest in the Southeast, where it ran above 15 per cent, and in the Mountain states, where it registered about 10 per cent. The former region has been leading the rest of the country for six consecutive months, its rate ranging from 14.4 to 20.6 per cent during that period. The eastern and central industrial regions advanced about 7 per cent against 9 to 10 in October.

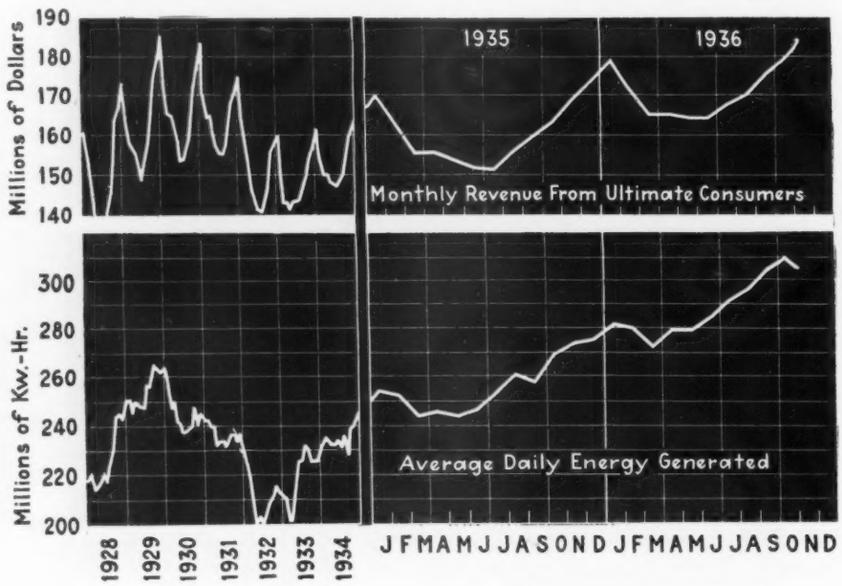


Table I—Monthly Revenue from Ultimate Consumers and Energy Output of Central Stations in the United States

Compared with Corresponding Month of Previous Year

Month 1936	Revenue from Ultimate Consumers†		Energy Generated, Millions of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.
November	183,066	+8.1	9,187	+12.0	3,055	0.0	6,132	+19.0
October	179,972	+10.6	9,639	+15.3	3,137	+17.6	6,502	+14.2
September	175,597	+10.4	9,177	+18.8	2,736	—2.2	6,441	+30.5
August	169,630	+8.7	9,178	+13.8	2,756	—10.7	6,422	+28.7

Table II—Regional Revenue and Energy Output in November, 1936

Compared with Corresponding Month of Previous Year

Geographical Region	Revenue from Ult. Consumers		Energy Generated, Millions of Kw.-Hr.*					
			Total		Hydro		Fuel	
	Thousands of Dollars	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.	Gen.	Per Cent Inc.
United States	183,066	+8.1	9,187	+12.0	3,055	0.0	6,132	+19.0
New England	15,683	+7.4	621	+8.0	270	+41.3	351	—8.5
Middle Atlantic	53,166	+7.1	2,357	+15.1	622	—1.7	1,735	+23.0
East No. Central	42,122	+6.7	2,290	+15.3	162	—15.7	2,128	+18.5
West No. Central	15,423	+8.0	593	+3.2	119	+26.7	474	+23.0
South Atlantic	24,475	+15.6	1,165	+14.2	612	+14.8	553	+13.5
East So. Central			331	+4.0	221	—6.7	110	+35.0
West So. Central	9,869	+8.6	444	+13.3	17	—29.2	427	+16.0
Mountain	5,573	+9.9	331	+18.0	226	+13.0	105	+31.5
Pacific	16,755	+4.6	1,055	+3.7	806	—4.6	249	+44.5

* By courtesy of Federal Power Commission, with deductions for operations not regarded as central station.
† Edison Electric Institute.

Steam carries the increase

Energy production, as usual, increased more than revenue. The total was 9,187,400,000 kw. hr., the gain over the preceding year 12 per cent. The entire increment was carried by fuel-burning plants, of which the output was 19 per cent greater than a year ago. This refers to the country as a whole. In several geographical regions the percentage was considerably higher, rising to 44.5 in the Pacific, 35 in the East South Central and 31.5 in the Mountain States.

Wholesale commercial energy sales, 54 per cent of the total and 19.1 per cent above a year ago, continue to reflect rising industrial activity. Domestic service, up 10.1 per cent, and retail commercial, up 12.9 per cent, contributed their share. Percentages in these major groups receded moderately compared with October.

Average domestic sales per customer for the twelve-month period again set new records, rising to 718 kw. hr. with the rate down to 4.76 cents.

Table III—Allocation of Energy November, 1936

Compared with Corresponding Month of Previous Year
(Edison Electric Institute)

Class of Service	Millions of Kw.-Hr.	Per Cent Inc.
Total for distribution*	9,238	+12.7
Lost in transmission, etc.	1,238	—2.6
Sold to ultimate consumers	8,000	+15.5
Domestic	1,419	+10.1
Com'l, small light and power	1,459	+12.9
Com'l, large light and power	4,315	+19.1
Municipal street lighting	225	+3.7
Railways—street, interurban	392	+6.5
Railroads—electrified steam	112	+42.8
Municipal and miscellaneous	78	+33.9

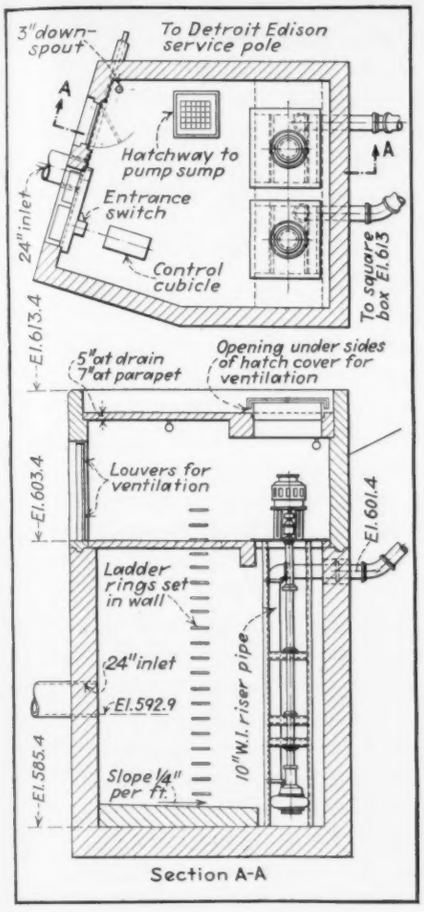
* Generated, purchased from other sources, imported, less energy used in railway and other departments.

Pumps Remove Storm Water

Michigan Puts in Electrical Pumping Facilities to Keep Traffic Moving on Depressed Highways by Freeing Them From Flooding

By C. C. RANCE

Bridge Division, Michigan State Highway Department



Plan and section of underpass pump house

DURING 1936, under the direction and supervision of Murray D. Van Wagoner, State Highway Commissioner, the Michigan State Highway Department inaugurated a grade separation construction program that involved approximately $7,000,000 for 25 underpasses and fourteen overpasses, making a total of 39 grade separations. In the overpass type the drainage problem is nil, but in the case where the highway is depressed to pass under the railroad the drainage problem rates considerable study and analysis.

For seven of these underpasses it was necessary to design six pump houses, three of the underpasses being located where there was no possibility of connecting to storm sewers and the four others being located where there were no storm sewers at all. The largest of the pump houses, handling the equipment of two grade separations, is described here.

The first step in the design of the pump house was to determine the area which will discharge its run-off during a storm into the underpass drainage system. In this particular case, after a careful analysis of the topography of the combined separations, it was found that there would be 3.26 acres of sodded area and 2.34 acres of paved area. Approximately one-third of the rainfall on sodded areas immediately runs off, the sod holding back the other two-thirds. In previous designs it was found that a figure of about 1,000 g.p.m. per acre for run-off is a safe figure to approximate. From these two figures, namely, 1,000 g.p.m. per acre and 3.43 acres, which is one-third of the sodded area plus all of the paved area, we are able to determine the total pump capacity. In this department use of two pumps has been standardized, therefore we have:

$$\text{Capacity of one pump} = \frac{1{,}000 \times 3.43}{2} = 1{,}715 \text{ g.p.m.}$$

The next step was to determine the probable head on the pump. This was done by checking with the road design division to ascertain the lowest point of its sewer system and making the center line of the pump 6 ft. lower than the invert of the sewer where it would discharge into the pump sump. This determines the pump centerline. The elevation of the point of discharge in this particular case was fairly simple because an open ditch was in close proximity to the pump house and was used for the outlet. From this we obtain a distance of 26 ft. for static head, to which we will add the friction losses in the discharge line and arrive at a figure of 29 ft.

An investigation of standard pumps as furnished by several leading pump manufacturers which will fit our requirement leads us to change the capacity of the pump to 1,600 g.p.m. Recalculating in the above formula due to the difference of pump capacity selected and the ideal, we reach a figure of 933 g.p.m per acre, instead of the assumed 1,000. This new figure will provide for 2.05 in. of rainfall per hour over the entire area. Besides rain, ground water may have to be considered, but this is a special problem requiring special treatment and does not figure in this job.

Pumps used are of the wet pit type, with the motor, thrust bearing and flexible coupling above the pump house floor. They are supported by vertical channels resting on the sump floor and also supported in the floor opening by cross channels in the form of a tee, with a floor plate attached to the cross channels. Pump motors are controlled by float switches, one for each motor, and the floats set for different levels to start the motor, but at the same level to stop. In ordinary use—that is, based upon government figures of average rainfall per month over a period of years—it was found that only one pump would be required to run four to five hours per month.

Since this installation is in Wayne County, it will be served by the Detroit Edison Company with three-phase, four-wire delta, 60-cycle service at 115/230 volts. After a conference between the Detroit Edison Company and the State Highway Department it was decided to try an outdoor metering set-up, using the meter-switch-fuse

[*Continued on page 88*]

Editorials

HOWARD EHRLICH . EDITOR

In the Time of Need

IT TAKES trouble frequently to show friends in their true colors. The holding company has been damned the country over as a leech sapping the strength of the operating companies. And now comes a flood, and what happens?

Thousands of things are needed, and needed yesterday. Copper, insulators, trucks, engineers, linemen, grunts, trouble-shooters, carpenters, pump men, drivers, operators, huskies who know how to use hooks.

Funds, cash, credit are needed—in electrical manufacturing plants hundreds of miles distant—as well as in the devastated area for canteens, extra guards, extra meals, extra this and extra that.

This is the time when arguments about one-eighth of a per cent difference in fees are part of another existence, when well-fed committees in spats and morning coats, dry, clean and comfortable as they pry into contracts, would only clutter the landscape.

Then it is that the holding company becomes to an operating company in trouble, an office building full of friends, competent friends, influential friends, deeply interested friends.

On one floor of the far-away office building these friends have had telegraph and telephone busy since yesterday. They have called sister operating companies. And yesterday line trucks completely equipped and linemen completely experienced started on a day-and-night run over the road.

There were no delays, there was no hesitation. No feet dragged. For next year one of these companies might itself be stricken and need help.

On another floor of the office building are other friends who know the system well. They probably designed it, inspect it periodically, and can look at their wall maps in their far-away offices and know exactly what is needed. It is these friends who long-distanced electrical manufacturers yesterday and ordered the materials into freight cars or onto overland trucks—the very material missing from the local warehouse stocks!

Here is the true holding company, performing its invaluable functions. Here is a device of modern times, created to perform useful work, dedicated to a social service.

May the day soon dawn when eloquent, forceful tongues in the public utility industry can show the holding company in such a rôle to the 120,000,000 American citizens who control its destiny.

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Familiarity With Process Will Guide Pole Specifiers

HOW many utility men who write pole treatment specifications have ever visited a creosoting plant? Those who have are aware of the limitations and possibilities of the process. By having first-hand information they do not specify details of procedure that may be uneconomic. They secure maximum pole life at minimum expense by specifying results that may be attained by the producer in alternative ways with consequent flexibility and economy.

Creosoting is no test tube job over a Bunsen burner. Wood is a natural product and varies. Climate varies and so does the seasoning season. Creosote varies somewhat in composition. Pole-charge volumes vary and so do the proportions of added creosote charge and carry-over. Shift schedules have to vary some if irregularities and overtime are not to be incurred. Undoubtedly, there are other even more important variables. The job is one of chemical processing.

None of this is any argument for relaxation of specifications. It may only mean a greater degree of tolerance, coupled with sympathetic inspection, to assure uniform results in subsequent pole life. It may lead to the unification of specification so that a smaller number would adequately serve the characteristic climatic and soil belts of the country. Even though the railroads still want custom-built treatment and highway and river boards ask for something still different, a higher degree of unity of demands from pole users should ultimately give uniformly longer life at progressively lowered costs for the treatment. At the very least, those who write the specifications would gain by having a look at the process.

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Integration Sought in New England

UNLESS the courts of the land shall have intervened, three hundred and thirty-five days hence the geographical integration and corporate simplification features of the Public Utility Holding Company Act of 1935 become of full force and effect. Of more than ordinary interest, therefore, is the news that Associated Gas & Electric and New England Power have worked out a plan whereby geographical integration and corporate simplification of certain New England properties may be expected in the near future.

The exchange contemplated involves only some $4,000,000 of securities, rather than cash, but if it is consummated the Associated unit receives control of two companies in Plymouth already connected with its Cape Cod and New Bedford properties, while the New England Power unit derives important minority holdings in such subsidiaries as Amesbury, Worcester, Marlborough and Weymouth, which are in its natural territory. All of the properties named are in the state of Massachusetts.

One of the country's leading independent consulting engineering firms has given its approval to the exchange—all in accordance with certain indenture provisions.

The situation presented will be watched by the industry with great interest. Here is a plan which first of all is apparently dictated by business-like considerations; secondly, is thoroughly consistent (a) with the geographical integration stressed by the holding company act, and (b) with the corporate simplification features of the act, for the New England Power unit derives important minority holdings indispensable to its own simplification plans.

Such a plan deserves prompt consideration by the S.E.C. and the Massachusetts Department of Public Utilities, for there are thousands of employees in the utility companies and additional thousands of owners of this private property who would be greatly cheered at the sight of two companies being allowed to work out what seems to be a mutually profitable plan on an ordinary business-like basis. Moreover, other companies which have been studying integration plans would be encouraged at the practical solution of some of the problems that have arisen as the result of the terms of the holding company act.

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Reddy Kilowatt Hits the 20 per Cent Mark

FRIENDLY observers of the public utility industry were pleased last week to learn that the mythical personification of the electrical servant, Reddy Kilowatt, will be greeting 4,000,000 customers on February 1, roughly 20 per cent of the total.

Reddy Kilowatt is a registered symbol, owned by Ash Collins of Birmingham. In this sense he is a commercial product, having no place in an editorial column.

But, in another sense, he is the best thing that ever came down the pike as an answer to the utilities' prayer for twenty years for something that would personalize the service.

Last June, at St. Louis, the convention delegates were exhorted to personalize the service, to humanize the service, to impress the service in a friendly way upon the consciousness of Mr. and Mrs. John Public.

Is Reddy Kilowatt the answer? Maybe not the whole answer, but certainly a part of it. So here's to the 60 public utility companies in all parts of the country who, until something better comes along, have turned Reddy Kilowatt loose in their advertising, on their bills, in their windows, in the showrooms to tell the customers of these companies in his own appealing way of the boon to mankind that electric service has become today.

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Larger Power Sales Attract Competition

LARGER sales and power prices for electricity sold to American industry appear from a comparison of 1936 figures with those for 1929. Last year 49,000,000,000 kilowatt-hours were bought by industrials and other large users. They paid $600,000,000 for them, at an average rate of 1.22 cents per kilowatt-hour. In 1929 the average rate was 1.38 cents, at which more than 44,000,000,000 kilowatt-hours were purchased and the bill was $613,000,000.

While that is an accomplishment for utility people to be proud of, there is another side to this situation that needs careful consideration.

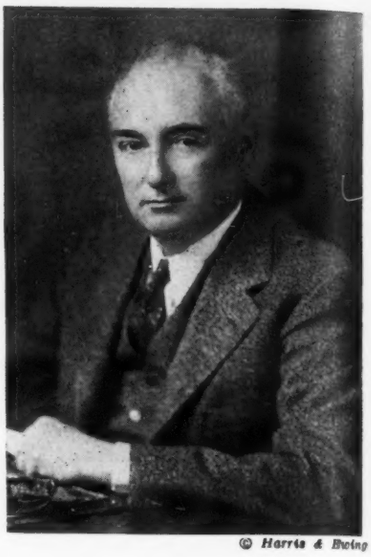
The record shows that while industrial production for 1936 was down 13 per cent from 1929, industrial power revenue in the same period was down only about 2 per cent. From this it is easily figured that the cost of purchased power per unit of industrial production has risen 12.5 per cent since 1929. In other words, the cost of electric power is taking a larger share of the industrial production dollar. In so doing, however, it has naturally made the business of industrial energy supply more attractive to competitive services.

In those utilities where complacency with good statistical pictures has no place, such competition, if of high technical merit and vigorous sales exploitation, can be very stimulating. Rates enter into the picture, of course, because the customer is accustomed to buying everything on a competitive basis. The extent to which customers will pay slightly higher rates for utility power than for competitive power depends upon how well the customer remembers all of the advantages he receives when he pays his power bill, such as enhanced reliability of service, immediate addition to service as required, quick restoration of service after breakdown, release of working capital and production space that would be necessary with a customer-owned plant.

In other words, there is still the job of keeping the power customer sold on his utility service. Since the story is not peculiar to any one utility company, it rightly becomes a co-operative activity. Such an activity should mean that the industry can safely continue to take an increasing share of the industrial customer's production dollar.

Rankin's Place in Power Controversy

By CARTER FIELD



© Harris & Ewing

This noted journalist gives his personal comments and interpretations on current happenings affecting the electrical industry. His background and his location at Washington make his thoughts informative and interesting even though all may not agree with him.

"I DON'T propose to make any allowance for good will or franchises to people who have been robbing the public for twenty years. An electric plant or an electric distribution system is like an old suit of clothes. You wouldn't pay as much for an old suit as for a new one."

These are two random sentences by John Elliott Rankin, Mississippi member of the House of Representatives, who is organizing a "Power Bloc" to fight for electrification of America *by the government*, to fight against any gridiron or pool system, and to fight for the ideas of David E. Lilienthal as against those recently voiced by Dr. Arthur E. Morgan. He was answering questions by the writer as to one detail of his recent announcecent about his power bloc. The questions related to how he would have the government determine what it would pay to present owners of electric plants and distribution systems.

The announcement, put out by Mr. Rankin, had stated:

"We favor the municipalities owning their own distribution systems. Where those distribution facilities are owned by private power companies we favor aiding the municipalities in buying them out, provided they can be purchased at their actual values. If no, then we favor aiding the municipalities in constructing their own distribution systems and stand-by plants."

With the ultimate object of government-produced-and-distributed electricity to every farmhouse in the land, Mr. Rankin's scheme includes no element of profit. He would fix the rates to cover mere cost of production and distribution and amortization of the original cost. When the amortization is completed, further rate reductions should be made, he insists.

"The rate should be the cost of production and distribution," says Rankin. "That's what a yardstick is."

"Did Senator Norris approve the idea of your power bloc?" he was asked.

"I am sure he approves of it," Mr. Rankin replied. "Senator Norris and I have never had a difference of opinion. But I did not consult him about this. Our bloc is a House matter. We have about 171 members now, and we will have more than half the members of the House very shortly."

"Did you consult the President before organizing the bloc?"

"No."

"What do you think of the controversy between Dr. Morgan and Mr. Lilienthal?"

"I am 100 per cent with Mr. Lilienthal."

Rankin has been a member of the House for sixteen years, having been first elected from the Tupelo district in Mississippi in 1920. His chief claim to fame is that he was co-author with Senator Norris of the original T.V.A. measure. Actually, of course, Senator Norris had been fighting for the old Muscle Shoals government power plant idea for several years before Rankin came to Washington, but no one has exceeded Rankin's enthusiasm for government ownership in the electric industry and his bitterness against the so-called "Power Trust" since he came to Washington.

His political perspicacity and his power views coincided, fortunately for him, in 1932, and he was one of the original Roosevelt men. In fact, he was so strongly for Roosevelt that he became slightly obnoxious to Senator Pat Harrison, of his state, at the Chicago convention by coming out publicly for abandoning the two-thirds rule, his only object being to be for everything that Jim Farley wanted, regardless of consequences to anything save the nomination of Roosevelt. Some of the senior Southern statesmen, including Senator Harrison, took a different view, and Farley backed down.

This bit of history is important now because of two things. First, Roosevelt and Farley are both strong for men who exhibited so much loyalty at that particular time. Second, it shows the singleness of purpose of Mr. Rankin, once he has decided on his objective.

In the House, however, Rankin has not demonstrated as much luck as he did in getting behind the Roosevelt candidacy. He was a candidate for Speaker against Henry T. Rainey in the 73d Congress, not making much of a showing. In the recent fight for Democratic leadership he was again a candidate, but not many members took his fight seriously. The real fight was between Sam Rayburn of Texas and John J. O'Connor, with Rayburn the victor. Rankin retired just before the caucus met.

Actually, Rankin is a more vociferous edition of George Norris, who half humorously and half seriously encourages him. And he comes a great deal closer to expressing Roosevelt's real ideas about the power situation than one might suspect by reading a lot of editorials on the Morgan-Lilienthal controversy. Rankin will always be out in front—in the direction he thinks Roosevelt is going. So far he has not been wrong very often, except in overestimating the esteem in which his colleagues hold him.

Letters TO THE EDITOR

Destroying Intellectual Integrity

To the Editor of ELECTRICAL WORLD:

At the recent meeting of the S.P.E.E. held in Madison the topics for the general meeting were of such a nature as to suggest that a Y.M.C.A. or ministerial conference was in session. The question in my mind was why should teachers of technical subjects devote time to a discussion of the "spiritual adjustment of the student." In mingling and talking with those attending the conference I became conscious of the cause for the presence of such a topic on the program. Although it was never concretely expressed, nevertheless one became aware of a prevailing sentiment and feeling that forces now more or less dominant in the intellectual life of the nation were destroying the intellectual morale and integrity of society, and that it behooved those whose training gave them a keen appreciation of the immutability of facts to stimulate a like recognition of certain fundamental verities, verities of intellectual integrity in their students. Unless this respect and recognition is re-established, society will disintegrate. I believe the motive impelling you to write the editorial "Engineers—Leaders or Followers" is akin, if not identical, with the animus that inspired the members of the S.P.E.E. in their recognition of the presence of forces destructive to the human spirit. The nation can live down and recover from the waste of money, but disintegration awaits it when the intellectual integrity of its people is destroyed.

Throughout these trying times I have been disheartened by the pusillanimity of the leaders in the engineering profession. I know no engineer in governmental service who attempts to justify the more fantastic notions now dominant, and yet most, if not all, engineers are strangely silent.

Although engineers as a whole are not actively participating in the spreading of propaganda, other agencies are, especially magazines. One example must suffice. *Harper's* in the January, 1935, issue had an article, "What About Public Works," by David Cushman Coyle. It would be difficult to find more fantastic ideas on economics than are found in that article. Nevertheless, the ideas expressed by Mr. Coyle seem to be those adopted by the government. Then, in the June, 1935, issue of the same magazine is found an article, "Power and the Public," by N. R. Danielian. Some of the statements in this article are not merely propaganda, but absolutely false. For example, he says: "Utility companies, under holding company leadership, have written up the value of fixed assets which is used as a rate base and upon which consumers must pay a fair rate of return to security holders." There is not a shred of evidence in the Federal Trade Commission's reports that the write-ups, so called, have ever been used as a rate base. In fact, the Federal Trade Commission itself makes no such claim.

Then in the July, 1936, number of the same magazine is found an article on "Teaching Grandmother How to Spin," by William Nichols. A more clever piece of propaganda in favor of T.V.A. would be difficult to compose. I wrote a reply and sent it to the editor of *Harper's*. He returned my manuscript, with the suggestion that I write a letter. To this suggestion I replied that I would if he would let me know how much space I could have. This letter was written on July 16, and up to date I have received no reply. Obviously propaganda is legitimate.

I agree with you most emphatically not only that the time is opportune for engineers to stand up and make themselves known, both in the industry and to the nation, but that it is their duty. I made this suggestion in a letter to the ELECTRICAL WORLD a long time ago. If I remember correctly, I also mentioned that it is the function of the American Engineering Council. No notice was taken of my suggestion. I hope that you have better luck.

C. M. JANSKY,
Professor of Electrical Engineering,
University of Wisconsin.

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Rural Line Costs

To the Editor of ELECTRICAL WORLD:

In the September 26 issue of ELECTRICAL WORLD the article "Rural Lines—Tractor Built" apparently refers to our company. The costs given are incorrect and we have had many letters of inquiry which make us believe you will wish to publish a correction.

The tractor mounted earth-boring and pole-setting machine which we purchased last April has been used every working day since that time. Two crews of three men operate it in two shifts each day in order to take advantage of all daylight hours.

While the unit can dig a hole 5 ft. deep and 16 in. in diameter, set a pole and move under its own power to the next pole location in a period of between three and four minutes, it is necessary to transport the tractor by truck to many locations within our territory of 4,500 square miles. This naturally reduces the actual operating hours of the machine, but notwithstanding this fact it has set over 7,000 poles during its first five months of service.

The fuel costs for operating the unit amount to $3.48 for each eight hours. Records of its operation to date show that it consumes 16 gallons of gasoline and 2 quarts of oil in an eight-hour period. At 18.6 cents per gallon, the gasoline costs us $2.98 and oil at 25 cents per quart adds 50 cents. Including both the operating cost of the machine and the wages of the operators, the cost of digging 50 holes and setting 50 poles totals $17, or 34 cents per pole.

Material and labor costs for a mile of 2,300-4,000-volt line without transformers and services are approximately $600. When including transformers and all equipment, ready for service, the cost is between $800 and $900 per mile.

F. A. HANSON,
Director of Public Relations,
Illinois Northern Utilities Company.

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Daylight Use Reduces Peaks

To the Editor of ELECTRICAL WORLD:

Noting in your issue of October 24, page 53, the letter of R. Kauffman of London and the editorial comment, it seems to me that there is still another important factor which affects the character of the load peak accompanying illumination increases.

Most lighting installations, especially those which tend to emphasize peaks, are operated to reinforce daylight. Thus the time of switching on in the afternoon and of switching off in the morning is determined by the benefits which the electric illumination confers upon the users. With artificial lighting, of a low level, no advantage is attained except when the daylight illumination is comparatively low. Thus it has been observed for many years that when foot-candles of electric lighting are increased the use extends more and more into the daytime. Today a large proportion of store and office installations in outside rooms are operated all through the working day. While this tendency is not so marked in homes, it is still there. So in this country, perhaps accelerated by the reductions in electricity rates, the lighting load is showing less of its former sharp peak characteristic.

From what little I have seen of European practice in this regard, I have noted markedly less of daytime usage of artificial lighting and have concluded that the lower illumination values accounted largely for the difference.

G. H. STICKNEY,
Nela Park, Cleveland.

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Accepted, With Thanks

To the Editor of ELECTRICAL WORLD:

When an outfit produces such an excellent piece of work as the January 2 Statistical and Review Number of ELECTRICAL WORLD, words of commendation should be forthcoming. Here's mine. "It is a swell job!"

My congratulations to the entire staff.

W. K. MCCANN,
Petersburg, Va.

News OF THE WEEK

Electric Utilities Pool Power Facilities to Aid Flood Area

Rising waters of Mississippi and Ohio rivers leave many communities in darkness as service is disrupted — Utility officials put into effect U. S. "grid" to bring relief — Equipment and crews sent to aid

Faced with one of the most devastating floods in the history of the country, which caused millions of dollars in damage to property and left scores of communities without utility service, electric power officials speedily gather together to put into service the U. S. "Grid" and bring relief to utilities in the flood-torn, water-covered area along the Mississippi and Ohio rivers.

With the rising tide of murky waters homes, office buildings and power plants were flooded. Plea for emergency aid came from leading utility officials in Cincinnati and other cities as plans progressed whereby electric service, interrupted and in some instances halted since a week ago, would again flow in the affected areas.

Ships equipment

General Electric Company announced that it has shipped twenty carloads of distribution transformers, cut-outs, lightning arresters and oil to the Cleveland warehouse which will act as headquarters for shipment to the flood affected areas. A construction crew has also been sent to the area to assist in restoring electric service.

The extent of damage to electric and other utility property could not be estimated although it is known to run into a sizable figure.

While utility officials were striving to speed restoration of electric service and receiving aid from interconnections the Federal Power Commission, oddly enough, sent telegrams to state commissions and utility companies stating that it was ready under authority "to authorize or if necessary order establishment of such interconnections and interchange of electric energy as required to meet emergency created by flood conditions."

As the Ohio River rose to 82 feet in Cincinnati the city was without water, electricity and gas. Dayton Power & Light Company tied in to supply the city with 40,000 kilowatts. Indianapolis tied in with another 20,000 kw.

As a power conserving measure the Ohio Power Company through the Philo plant near Zanesville, Southern Ohio Electric Company, through Floodwood and Picway, and Appalachian Electric Power Company are serving the Ohio River Valley and are keeping the lines out of the rising waters with bayonet extensions.

Louisville out

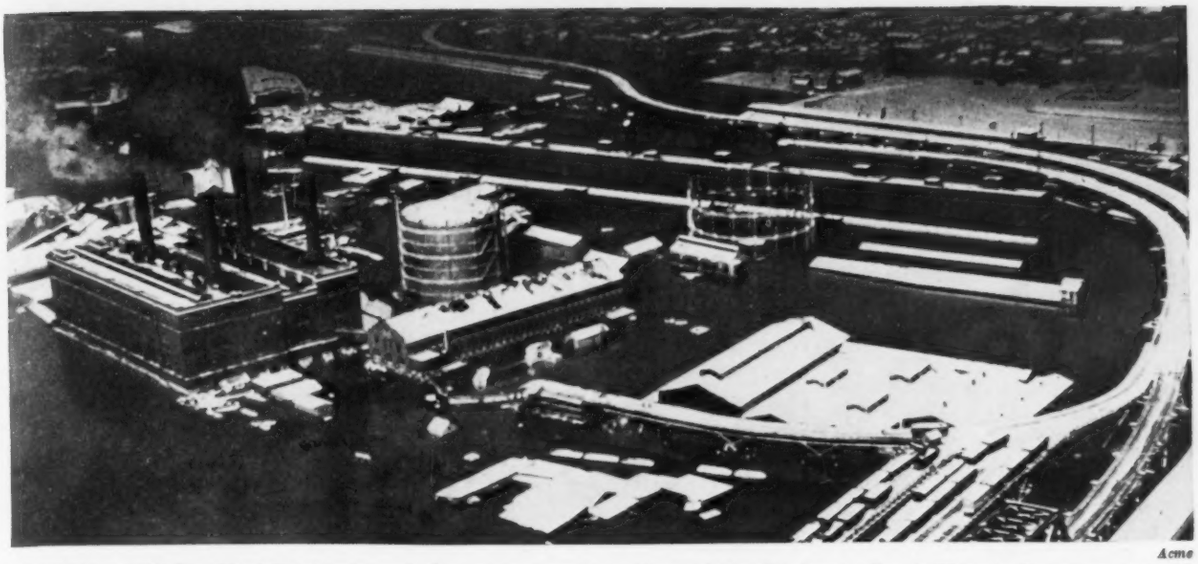
Completely surrounded with water, and 90 per cent covered, Louisville, Ky., has had no gas or electricity from the Louisville Gas & Electric Company plants since last Sunday. Utility plants in the vicinity are ready to render all possible aid.

In southern Illinois flood waters swept over a wide area disrupting all public service and leaving many homeless. Central Illinois Public Service Company reported water in its turbine room but the plant was in operation. Central Illinois Light Company at Springfield was in operation and supplying service.

As the flood waters continued down

Wide World

FLOOD IN KENTUCKY—An airview of the power house of the Louisville Gas & Electric Company, centered in a broad lake of flood waters and partly submerged. The city burned candles when electricity failed in one of the worst flood disasters



Acme

FLOODED POWER PLANT—Airview of the steam-generating plant of the Cincinnati Gas & Electric Company as flood waters of the rising Ohio River surrounded the plant, cutting off the city's light and power. Partial service was maintained and additional power obtained from other cities.

the Mississippi reports came that many communities were preparing for trouble. Electric plants along the route of the flood waters were taking precautions to protect service as far as possible.

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Toledo Gas Employees End Ten-Day Strike

The ten-day-old gas strike in Toledo by employees of the Ohio Fuel Gas and the Northwestern Ohio Natural Gas companies, units in the Columbia Gas & Electric system, was settled this week when members of the Gas Employees' Union voted to accept an agreement providing wage increases ranging from 5 to 40 per cent.

Provisions in the settlement of the strike included vacations with pay, a one-year contract, a forty-hour week, dismissal wage in case of retrenchment, an overtime rate of time and a half and double time, a "more adequate" seniority system, pay retroactive to January 1 and sick benefits.

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Stock Sale Postponed Again

Circuit Court Judge Manton has signed an order restraining New York Trust Company until February 10 from selling at auction the 712,411 shares of Jersey Central Power & Light Company common stock, collateral for National Public Service Corporation debentures. The auction had been scheduled for January 29.

Conferences on T.V.A. Power Pool Dropped by Roosevelt

President states that injunction against Federal agency precludes joint transmission agreement — Action seen as "war" on utilities seeking relief in the courts — Willkie says lawsuit was necessary for protection

Upon the basis that the electric utilities operating in the Tennessee Valley have resorted to legal protection against subsidized competition from the T.V.A., President Roosevelt discarded any future discussions which might lead to an agreement in the pooling of power by the government and the utilities in the Southeast.

The President announced this week that he is discontinuing conferences on this subject. Such an arrangement has been precluded by the sweeping injunction against the Tennessee Valley Authority obtained by nineteen utility companies, he said.

Such an announcement came only a week before the expiration on February 3 of the temporary working agreement between Commonwealth & Southern Corporation and the T.V.A. It revived the opinion expressed last fall before the November election that the Southeastern power pool conference called by Mr. Roosevelt was purely a political gesture to gain the support of the millions of utility investors.

The termination of the negotiations leading to the joint use of power facilities in the T.V.A. area was done in a letter addressed to the federal officials and public representatives who attended the conference last fall. The President stated that the injunction against the T.V.A. "precludes a joint transmission facility arrangement and makes it advisable to discontinue these conferences."

Starts lawsuit

Mr. Roosevelt stated that the question of renewing the interchange agreement between T.V.A. and Commonwealth & Southern is still open. Apparently consideration of this had been deferred pending the possibility of a pooling agreement. Since the latter is definitely impossible, the way is open for renewed negotiations.

Wendell L. Willkie, president of Commonwealth & Southern, stated that "on May 21, 1936, I advised the President that, in view of the competitive warfare which the Tennessee Valley Authority was waging against our companies, it would be necessary to start a comprehensive lawsuit, testing the constitutionality of the Tennessee Valley Authority operations; that unless we did so we might waive our right ever to do so. On May 29 this lawsuit was filed.

"On August 19 an application for a temporary injunction was filed. This application, which was pending at the time of the White House conference, sought much broader relief than was later granted by the court.

"On September 17 the President invited us to a conference to discuss the creation of a power pool or grid system. This conference was held on September 30. At the conference it was suggested by one of the T.V.A. directors that we should delay or dismiss the lawsuit.

"This I declined to do unless the T.V.A. would likewise discontinue the duplication of our transmission and distribution systems. The T.V.A. declined in the slightest degree to do so, and, by the same token, I declined to alter the progress of the lawsuit. The President did not then, nor at any time before or after, suggest any question or criticism in regard to either the lawsuit or the application for the temporary injunction."

It was pointed out by Mr. Willkie that after the conference the T.V.A. increased its activities in duplicating the transmission and distribution systems of the utilities. Mr. Willkie also expressed surprise that the injunction precludes either the pooling of transmission, the studying of the various problems arising out of the T.V.A. operations or the working out of a permanent solution. He said that the dropping of the lawsuit would place his companies at the mercy of the uncontrolled discretion of the T.V.A.

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Plan Engineering Courses

Announcement has been made by the power group, New York section, American Institute of Electrical Engineers, of three engineering courses to begin in February at the Engineering Societies Building, 33 West 39th Street, New York. One course is in electrical engineering for New York professional engineer license applicants, W. Glendinning instructor; the second in structural planning and design, also for New York professional engineer license applicants, S. W. Spielvogel instructor, and the third in public speaking, R. C. Scafe, instructor.

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E.H.F.A. Gets New Life

Congress has passed a bill extending the life of the Electric Home and Farm Authority until June 30, 1939.

Ickes Power Group to Speed Report on National Policy

Secretary of Interior states recommendations will be limited to Bonneville legislation — General plan for other federal projects to be considered later — Landis replaces Healy — Cohen named counsel

The National Power Policy Committee, appointed by President Roosevelt last week, hopes to make its first report next Monday, according to Secretary of the Interior Harold L. Ickes, chairman. This, however, will be limited to recommendations on Bonneville legislation, leaving consideration of general power policy for future consideration, it was stated.

Present indications point toward the recommendation by the committee of the enactment of the Bonneville bill which sets up the Federal Power Commission as a general policy-determining body for all federal power-generating projects, including T.V.A.

The committee is meeting every day and is receiving views of interested government officials. When asked if utility views would be heard, Mr. Ickes said: "No." Upon further interrogation as to whether or not T.V.A. had been heard, he again said "no," as they have no interest in the Bonneville problem.

Landis named

James M. Landis, chairman of S.E.C., had been appointed to the Power Policy Committee to replace Judge Healy, who is ill. Benjamin V. Cohen is counsel of the committee.

Organization of a public power bloc among members of the House of Representatives was perfected last week, with Representative John E. Rankin of Mississippi, who is making a bid to follow in the footsteps of Senator Norris, vitriolic foe of the utilities and advocate of public ownership, as chairman. Representative Knute Hill of the State of Washington is secretary.

A resolution containing the outline of their policies said in part: "We are unalterably opposed to pooling the public power produced by the T.V.A. . . . or at Boulder Dam, Bonneville or Grand Coulee . . . or by any other governmental project or agency with that of any private power company, or private distribution agency. . . . In order to avoid duplication, we favor the government's purchasing the transmission lines where they would parallel the public lines necessary to carry public power to its destination, provided these lines can be purchased at their actual values. If not, then we favor the government's building its own transmission lines, regardless of duplication."

Investors concerned

Investors are deeply interested in the proposal to establish a national public policy with respect to the relationship between power plants constructed, owned and operated by the government, and the investor-owned plants with which these government projects come into competion, said Dr. Hugh S. Magill, president, American Federation of Investors. "Investors feel that their interests as well as the interests of the public would be best conserved by such an equitable adjustment of policy that would terminate the struggle that has gone on for several years between the government and private utilities . . . ," Mr. Magill commented.

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Utility's Boulder Dam Pact Assumed by Los Angeles

Secretary of Interior Harold L. Ickes has approved a form of contract between the United States on the one side and the City of Los Angeles and the Los Angeles Gas & Electric Corporation on the other by which the city may take over the utility company's Boulder Dam power purchase contract as a public ownership operation.

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Boston Plans Superposed Unit for L Street Plant

Specifications are being prepared for the Boston Edison Company under which the generating capacity of the L Street station in South Boston will be increased by the installation of a high-pressure turbo-generator unit of approximately 25,000 kw. rating and by boiler equipment bringing the total added capacity to the vicinity of 75,000 kw. It is expected that a steam

pressure of the order of 1,400 lb. will be utilized for serving the new turbo-generator. This increase in capacity for the company's most important in-town plant will constitute the first major addition to its generating facilities for many years.

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Seattle City Light Asks Equipment Bids

Bids for the major electrical equipment for Seattle City Light Department's new million-dollar South substation, terminal of the proposed 220-kv. line from the recently completed Diablo hydro plant, will be received February 15 by the Seattle Department of Public Works.

An outdoor receiving station of the most modern type, South substation will be an important unit in the municipal utility's system. Equipment to be purchased includes the following items:

3 20,000-kva., 220/13.2-26 kv. power transformers.
1 30,000-kva., 13.8-kv. hydrogen-cooled synchronous condenser.
1 196/230-kv., 1,200-amp., 2,500,000-kva. oil circuit breaker.
1 196/230-kv., 600-amp. disconnect switch.
2 15-kv., 1,600-amp., 750,000-kva. oil circuit breakers.
3 15-kv., 1,600-amp. disconnect switches.
2 34.5-kv., 2,000-amp., 1,500,000-kva. oil circuit breakers.
14 34.5-kv., 600-amp., 1,500,000-kva. oil circuit breakers.
3 34.5-kv., 2,000-amp., disconnect switches.
24 34.5-kv., 600-amp., disconnect switches.

The disconnect switches are to be of the gang-operated, air-break type.

Alex Dow Awarded Edison Medal at Mid-winter Meet of A. I. E. E.

Electrical engineers gather in New York for annual convention to discuss and seek solution to major problems — MacCutcheon calls for greater effort in meeting challenge for future accomplishments

Electrical engineers were called upon this past week to lend every effort to overcome some of the difficult present day problems with a deep and sincere resolve toward greater accomplishments throughout the year by A. M. MacCutcheon, president of the American Institute of Electrical Engineers and engineering vice-president of the Reliance Electric & Engineering Company, Cleveland.

Speaking before the annual mid-winter convention of the A.I.E.E. Mr. MacCutcheon stated that every alert-minded engineer is keenly interested in the future accomplishments and this year offers a challenge to greater effort.

At the Wednesday night session Alex Dow, president of the Detroit Edison Company, was awarded the A.I.E.E. Edison medal for 1936 for "outstanding leadership in the development of the central station industry and its service to the public."

The power industry is being injured by the "widespread and exaggerated enthusiasm" of those who are constantly urging the development and extension of electric power, John C. Parker, vice-president of Consolidated Edison Company, declared.

The extension of electric power service to all rural areas of the nation was declared impractical and needless by Mr. Parker. Electric service for a long time "must continue unavailable" in vast regions of this country, he said. "The most distressingly backward of our rural communities do not in all conscience need electric power, either economically or as adjuncts to living, one-tenth as much as they need many other things closely at hand but still frightfully difficult of attainment within a farm income restricted so narrowly as to make impossible many of the mere decencies of life."

In accepting the medal Dr. Dow said, "get along peaceably, but fight when you have to. Play fair with all divergent interests. No welfare system is a substitute for personal contact."

Louis H. Egan, president Union Electric Light & Power Company, painted both the kindly human side and the vision that has made Dr. Dow a leader in sound utility management.

Vacuum tubes

Improvement in fabrication of vacuum tubes and their expanding use in electric welding, automatic power station control and in the communication industry was singled out as one advancement being made by the en-

ENGINEERS CONVENE—Electrical engineers gathered this past week in New York City for the winter convention of the American Institute of Electrical Engineers, talked over their problems and renewed old acquaintances. Left to right: J. E. Clem, K. K. Paluev, P. L. Alger, A. Boyajian. Shaking hands with C. A. Powell, director of the A.I.E.E. (right) is A. C. Monteith

A. M. MacCutcheon, president of A.I.E.E. (right), talks with Prof. W. H. Timbie of the Massachusetts Institute of Technology

gineering profession. The fabrication of the "Fernico" (iron, nickel, and cobalt) has expanded the application of the vacuum tube to many new industries and particularly to electric welding, it was stated.

Mr. MacCutcheon stated that the convention this year was one of the best and that great advancements have been made during the past few years in the application of engineering science and art to industry. Privately he said that charges that engineering advancements were the cause of technological unemployment were inaccurate. Such advancements, he said, have paved the way for new industries and increased employment in addition to raising the standard of living for the worker.

Leading engineers of the country presented technical papers and discussions of the major problems of the day. The use of shielding wires on high tension power lines has reduced the number of flashovers and resulting short circuits following lightning to one-fifteenth the number which occurred before such wires were installed, according to W. W. Lewis and C. M. Foust, electrical engineers of the General Electric Company.

G. W. Penny, of Westinghouse Electric & Manufacturing Company, presented a paper on the new electrostatic precipitator which holds relief for the sufferers of hay fever.

During the course of the convention many interesting trips were arranged in addition to a delightful smoker and dinner dance.

More than one thousand electrical engineers from all parts of the United States and several from foreign countries gathered for the annual meeting to discuss technical problems.

Developments to Detect Line Faults Proposed at Meeting

Use of abnormal frequency harmonics present on power systems during trouble urged to find and segregate fault conditions — Compensated sheath cable discussed by Thomas — Discuss load testing

Proposal was made by Logan and Richardson of Georgia Power at the E.E.I. transmission and distribution committee meetings at Philadelphia last week that the abnormal frequency harmonics present on power systems during trouble be used to detect and segregate fault conditions. Development of this technique is, in fact, progressing in field and laboratory studies on the Georgia Power system.

Another development reported was of a compensated sheath cable by E. R. Thomas of Consolidated Edison Company. This is a 27-kv. tie of 800-amp. rating between Hell Gate and Waterside involving two submarine crossings. There is a rubber tension belt outside the lead, acting hoop-fashion at some 55 lb. per square inch to keep the lead from expanding away from the insulated conductors under load. Operation over ten months has been satisfactory and fifteen to twenty year elastic life of the rubber is expected.

Load testing

Secondary overcurrent protection was up for discussion, but, try as the chairman would to keep it there, the trend was to discuss transformer overloading and load testing. The upshot was that the latter subject is to be revived for full treatment and secondary overcurrent protection is to lie dormant.

H. A. Dambley of Philadelphia said that 40 per cent of secondary interruptions other than lightning are due to faults between transformer and service entrance and that secondary breakers can be made to follow thermal characteristics of transformer better than fuses. Some 70 to 80 per cent of the cost of a secondary breaker can be justified on the basis of saving the transformer against burnout, the rest credited to increased loading. J. A. Tenbrook added that above 10 or 15 kva. there was no apparent economic value in secondary protection because of better load diversity and increased short circuit capacity for burn-off. W. F. Nimmo of Richmond, Va., said that almost invariably a voltage complaint is received before a transformer is lost because of overloading and that 3-kva. units are commonly used to serve 10-kw. ranges.

Benefits comparable to investment of more than $700,000 in a duplicate line being derived from an investment of only $30,000 for rapid reclosure of the existing circuit were reported by Merrill De Merit. Further, a breaker was remodeled to open and reclose for less than $5,000, whereas a new one would have cost five times that figure. H. W. Eales reminded the group of the derating which goes with rapid reclosure.

Expulsion gaps

Experience shows satisfactory performance of expulsion gaps on 11–33-kv. distribution circuits, but economy seems to limit the application to lines with short spans, said Nicholas Stahl of Allentown, Pa., in summarizing the discussion on that topic. Some use the tubes on every third or fourth pole and others doubt their economic application to any lines of less than 66 kv.; apparently none are being used to protect transformers except those inbuilt.

•

Gulf States to Increase Plant Capacity 50 per Cent

Initiating an expansion program that will extend to the spring of 1938 and add 50 per cent to the Neches River plant at Beaumont, Tex., the Gulf States Utilities Company has contracted for a turbine to cost more than $500,000 from Westinghouse Electric & Manufacturing Company. T. P. Walker, president of the Gulf States Company, announced that other estimates to be received shortly will include those for building, boiler work and other features. Stone & Webster will handle all engineering work in connection with the program. A new 27,500-kw. unit will be added to the station's present capacity of 57,000 kw.

Commission Extols Conference Method

The conference method of bringing about reductions in electric and other utility rates in Maryland proved decidedly successful during 1936, according to a report just made by the Maryland Public Service Commission. The conference method during 1936 resulted in reductions in electric rates which save the consumers approximately $902,000 a year. Conferences are held between commission officials and officials of the various utility companies.

The commission announced that most of the electric companies have co-operated with it in its efforts to extend electric service into rural sections, the companies liberalizing their rules in order to comply. The total extensions have not been compiled, but the commission said that preliminary studies indicate that the construction last year was much greater than in 1935, when about 160 miles of rural lines were erected.

A total of 24 electric light companies and five gas and electric companies were under the jurisdiction of the state commission at the end of 1936, according to the commission.

•

Earle Demands Rate Cuts Apply to Homes

A resolution to the effect that the declared policy of the Pennsylvania Public Service Commission is to apply future reductions in utility rates to charges of residential consumers has been sent to Gov. George H. Earle. The action followed receipt of a letter from Governor Earle that the commission "formally adopt my wishes as its policy."

Governor Earle has come out in the open with a proposal to rip out the commission and substitute a Utilities Control Board with more stringent powers to regulate utilities. A majority of the commission oppose the move, pointing to the accomplishments made by the commission in utility regulation.

The proposal to slash rates to commercial consumers $500,000 made by Duquesne Light Company has been refused by the commission. The company was requested to apply the proposed reduction to householders in Pittsburgh. It was also suggested by the commission that the company simplify its rates by reducing or eliminating room charges. The company contended that the rate cut in 1935 effected a saving of $1,281,460 annually to residential customers.

•

Eta Kappa Nu Honors Five Young Engineers

Frank M. Starr of Schenectady has been selected as America's outstanding young electrical engineer for 1936, according to an announcement by Eta Kappa Nu, honorary electrical engineering association. Mr. Starr was selected from a group of 47 candidates of less than 35 years of age nominated

Frank M. Starr

by leading industrialists and educators. Presentation of the award was made at a dinner given in New York this week.

Peter Bellaschi, engineer of Westinghouse Electric & Manufacturing Company, Eugene W. Boehme of General Electric Company, Dr. Anatoli C. Seletsky of Case School of Applied Science in Cleveland and Cyril G. Veinott of Westinghouse Electric & Manufacturing Company were cited for honorable mention.

The selection was made by a committee of judges consisting of E. B. Meyer, junior past-president of the A. I. E. E.; L. W. W. Morrow, former editor of ELECTRICAL WORLD; the late Gen. R. I. Reese of the American Telephone & Telegraph Company; C. A. Butcher, vice-president of Westinghouse Electric & Manufacturing Company; Everett S. Lee of General Electric Company, and Roger I. Wilkinson of the Bell Telephone Laboratories.

Mr. Starr's contributions to the electrical art have been chiefly in the field of central station design and power distribution. His researches and inventions in devising equivalent circuits for solving power problems have resulted in the adoption by power operating companies of new and more exact methods for calculating system performance.

Born in Fowler, Colo., in 1905, Mr. Starr graduated from the University of Colorado in 1928. He is now connected with the central station engineering department of General Electric Company.

•

T.V.A. Completes Power Line for Chickamauga Plant

The T.V.A. transmission line from Chickamauga to the Watts Bar dam site northeast of Dayton, Tenn., has been completed and will tie in the Chickamauga generating plant with the Wilson-Norris transmission line.

The line stretches 49.5 miles up the east side of the river and will connect with the Wilson-Norris line at Pinhook Ferry. There are 214 towers in the stretch with the average distance from tower to tower of 1,221 ft. Only a few are less than 1,000 ft. apart. The line will carry 154,000 volts and is of the single-circuit type. The aluminum wire is the same type as that used in the Wilson-Norris line, but the towers, though of the same type of construction, are somewhat higher than those in the larger line.

•

59-Mile Line Approved

Construction of 59 miles of 110,000-volt electric power transmission lines between Parkin and Blytheville in eastern Arkansas at a cost of more than $300,000 has been authorized by the Arkansas Utilities Commission. Applications had been filed by the Arkansas Power & Light Company and the Arkansas-Missouri Power Company. Arkansas Power & Light had previously been authorized to construct a 42-mile line from Parkin to Osceola at an estimated cost of $200,-950. The Arkansas-Missouri company proposes to build a line from Blytheville to connect with the other company's line near Osceola. This line will cost $136,000.

Mohawk Hudson Plan Is Urged by Carlisle

Testifying last week before the New York Public Service Commission, Floyd L. Carlisle, chairman of the board of the Niagara Hudson Power Corporation, urged approval of the company's application to merge the Mohawk Hudson Power Corporation with the Niagara Hudson company.

The result of the merger would be operating and tax economies which would enable the company to revise rates to consumers downward, Mr. Carlisle declared. He indicated the intention of the Niagara Hudson system to merge into itself as many as possible of its present subsidiaries.

Mr. Carlisle stated that the proposed merger with Mohawk Hudson would save the company at least $1,200,000 annually in preferred dividend requirements. The elimination of the Mohawk Hudson as an "unnecessary holding company" was influenced by recent laws, Mr. Carlisle told the commission, pointing to the 15 per cent tax on intercompany dividends.

•

Injunction Extended Against "Little T.V.A."

A formal decree extending until October 1 the existing injunction against the power features of the three Nebraska irrigation projects financed by P.W.A. was granted the Iowa-Nebraska Power & Light Company by the United States District Court of Columbia.

The degree, restricting activities in the "Little T.V.A." projects in Nebraska, modifies the injunction obtained by the company last May and permits the three Nebraska power districts—Platte Valley, Loup River and Central Nebraska—to proceed with the irrigation features of their development, but forbids construction on power phases of the undertakings.

•

Fire Hazards Seen in Wiring of Farms

A new field of fire hazards is being created by electrification of farms which are often remote from electrical inspectors, according to reports at the recent annual midwinter directors' meeting of the National Fire Protection Association held in Atlantic City. All businesses in the United States and Canada were represented.

Franklin Wentworth of Boston, managing director, stated that amateur wiring often is done and technical knowledge is lacking. He said that this is causing a grave problem as the government and the utilities are pushing rural electrification.

Fire losses in the United States and Canada, Mr. Wentworth stated, increased about 10 per cent in the last year through industrial revival. Fire insurance rates have been going down steadily for ten years, he declared.

•

Refrigerator Measure Passed

The Senate has passed the bill providing for the authorization of the exchange of "used parts of mechanical refrigerators, hermetically sealed refrigerating units, temperature control devices," for new or reconditioned parts. There seems to be a better than even chance that it will be approved in the House with no opposition.

Meetings

Edison Electric Institute—Electrical Equipment Committee, Biltmore Hotel, Dayton, Ohio, February 8-9. J. F. Fairman, chairman, 4 Irving Place., New York, N. Y.

Electric Metering Conference—Deshler Wallick Hotel, Columbus, Ohio, scheduled February 9-10, postponed. J. N. Schwartz, Columbus Railway, Power & Light Company, Columbus, Ohio.

National Electrical Manufacturers Association—Midwinter meeting, Waldorf-Astoria Hotel, New York, February 14-18. W. J. Donald, managing director, 155 East 44th Street, New York.

American Institute of Mining and Metallurgical Engineers—Annual meeting, New York, N. Y., February 15-18. A. H. Parsons, secretary, 29 West 39th St., New York, N. Y.

Association of Iron and Steel Engineers—National meeting, Ohio Hotel, Youngstown, Ohio, February 25. Brent Wiley, managing director, Empire Building, Pittsburgh, Pa.

American Society for Testing Materials—Committee Week, Palmer House, Chicago, Ill., March 1-5. R. E. Hess, assistant secretary, 260 South Broad St., Philadelphia, Pa.

National Fire Protection Association—Electrical Committee, Atlantic City, N. J., March 9-12. A. R. Small, chairman, 207 East Ohio St., Chicago, Ill.

National Oil Burner and Air Conditioning Exposition—Philadelphia, Pa., March 15-19. C. F. Curtin, exposition manager, Oil Burner Institute, 30 Rockefeller Plaza, New York, N. Y.

Chicago Electricians in Three-Hour Strike

The strike of municipally employed electricians in Chicago last week, which tied up traffic and brought inconvenience to citizens, ended as abruptly as it started. During the nearly three-hour strike street lights went out, traffic signals ceased to operate and bridges over the river were raised to halt the traffic flow.

With other municipal employees, the electricians have been working under a reduced pay scale that was adopted as a depression economy measure. The electricians sought to use the strike weapon to force the city to increase its budget to include pay increases. Michael J. Boyle, leader of the electrical unions in Chicago, directed the strike.

On the day the strike was called the Superior Court of Cook County dismissed 25 suits seeking the return of about $19,000,000 in depression pay cuts to 10,000 city employees. Since the 1937 city budget, which did not include restoration of pay cuts, had been passed and no immediate wage settlement could be effected, the strikers returned to work.

At a special meeting of City Council it was decided to ask the state government for legislation enabling the city to levy additional taxes—probably license fees or some kind of local sales tax—in order to restore wage cuts to all city employees.

•

E.E.I. Equipment Committee to Hold Meeting in Dayton

Announcement was made this week that the Electrical Equipment Committee of the Edison Electric Institute will meet February 8–9 at the Biltmore Hotel, Dayton, Ohio, instead of the Netherland-Plaza Hotel, Cincinnati, as originally planned.

•

Buzzard Roost Hearing Set

Retrial of the Greenwood County, S. C., "Buzzard Roost" case has been set for February 23 before Judge J. Lyles Glenn at Rock Hill, S. C. This decision was announced last week following a conference at Columbia, S. C., between government and Duke Power Company attorneys. The case was remanded to the district court by the U. S. Supreme Court.

Output Continues Near Record

Central station energy output increased its lead, during the week ended January 23, over the corresponding period a year ago to 15.7 per cent, compared with 14.9 per cent in the preceding week. The total, amounting to 2,256,795,000 kw.-hr., was only 1 per cent less than the all-time record set in December. A slight decline, about 0.3 per cent, from the output reported a week ago may be interpreted as signaling the beginning of the downward trend that is normal at this season of lengthening daylight.

Regional percentages reveal significant advances over 1936 especially in the industrial parts of the country. The central area leads with 19.1 per cent, despite the automobile strike; New England is at the highest point ever reached since these weekly statistics were started; the South continues high; the Pacific region is moving up.

Weekly Output, Millions of Kw.-Hr.

1937	1936	1935
Jan. 23..2,257	Jan. 18...1,950	Jan. 19...1,778
Jan. 16..2,264	Jan. 11...1,971	Jan. 12...1,773
Jan. 9..2,244	Jan. 4...1,855	Jan. 5...1,669
Jan. 2..2,069	.....	.....
1936	**1935**	**1934**
Dec. 26..2,081	Dec. 28..1,847	Dec. 29...1,650
Dec. 19..2,275	Dec. 21...2,002	Dec. 22..1,788

Per Cent Change from Previous Year

Region	Week ended Jan. 23	Jan. 16	Dec. 19
New England	+17.9	+17.1	+10.2
Middle Atlantic	+14.6	+12.5	+11.4
Central Industrial	+19.1	+18.1	+15.6
West Central	+ 7.8	+ 9.3	+11.0
Southern States	+18.3	+18.2	+16.1
Rocky Mountain	+ 4.0	+13.0	+15.9
Pacific	+12.4	+11.6	+ 7.7
United States	+15.7	+14.9	+13.6

Hartford Electric Proposes New Bonds

Stockholders of the Hartford Electric Light Company at the annual meeting, February 2, will be asked to approve the proposal to issue and sell $5,000,000 of debentures to bear interest at not to exced 3¼ per cent. It is proposed to sell at this time $3,500,000 of the debentures to finance the installation of a 40,000-kw. steam turbine at the South Meadow generating plant.

In a letter to stockholders E. S. Nutting, secretary, stated that the flood damage of last spring totaled about $600,000, exclusive of loss of revenue. Most of this was charged to retirement reserves. Loss of coal and oil totaled $116,000, which was charged to surplus.

It was stated that commercial rate reductions put into effect last April resulted in a saving of $200,000 to customers.

•

Middle West Units Plan $15,890,000 Construction

Preliminary construction budgets for this year of the operating subsidiaries of the Middle West Corporation total $15,890,000, according to D. C. Green, president. Of this amount $13,750,000 represents estimated expenditure outlay during the year and $2,140,000 represents expenditures to be made in 1938 on projects approved this year. No major financing is necessary by any of the subsidiaries to take care of their construction requirements, Mr. Green declared.

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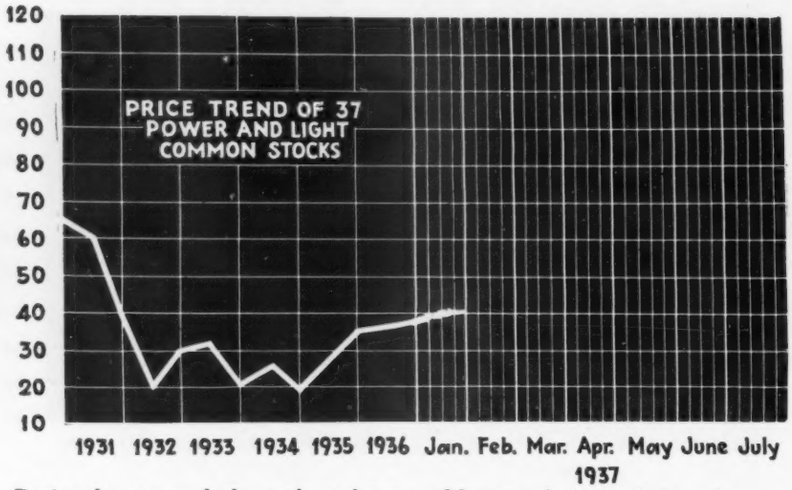
Plan Electric System

City officials of Clarksville, Tenn., are considering the construction of a complete electric distribution system at a cost of approximately $250,000. A bond issue has already been approved.

Utility Stocks Drift Downward



During the past week the stock market moved lower and electric light and power issues participated in the general decline. "Electrical World" index, 40.5; last week 41.4

Utilities Register New Loans with S.E.C.

Several substantial security issues have been filed with the S.E.C. by electrical light and power companies.

Dallas Power & Light Company, $16,000,000 first mortgage 3½ per cent bonds, due 1967. Proceeds will be used mostly for refunding purposes, but a small portion will be added to working capital and will be used for extensions and improvements in accordance with the provisions of the franchise from the city of Dallas.

Atlantic City Electric Company, $18,000,000 general mortgage 3¼ per cent bonds, due 1964. Proceeds to the extent of $17,799,851 will be used to purchase from the American Gas & Electric Company for cancelation certain bonds of the company and to deposit with the respective trustees, in trust, cash equal to the principal and premium required for the redemption of bonds of the company, amounting to $3,887,520, and for the redemption of bonds of the Electric Company of New Jersey, cost $1,255,112.

Iowa Public Service Company, $14,200,000 first mortgage 3 3/4 per cent bonds, series of 1967, and $2,200,000 serial debentures due on February 1 of each year from 1938 to 1947. Proceeds will be used for refunding and other corporate purposes.

Broad River Power Company has filed an amendment with the S.E.C. postponing proposed offering of $6,000,000 of 4½ per cent first mortgage bonds to February 10.

S.E.C. has permitted Derby Gas & Electric Corporation, a registered holding company and a subsidiary of Utilities Power & Light Corporation of Chicago, also a registered holding company, to withdraw a declaration under the Public Utility Holding Company Act of 1935 covering the issuance of a $5,000,000 5 per cent collateral judgment note.

•

Delisting of Utility Stock Granted by S.E.C.

The Securities and Exchange Commission has authorized the Connecticut Railway & Lighting Company to withdraw 89,772 shares of common stock from listing and registration on the New York Stock Exchange at the close of trading on February 5. The S.E.C. stated that it had received application of the company for withdrawal of the stock from listing on August 6, 1936, following action of the exchange in suspending the stock from trading at the close of business on August 5.

In granting the permission the S.E.C. stated that it did not attempt to determine the conflicting claims as to whether this stock has value. "To do so would be to put the government in the business of investment counsel," it was stated.

•

Dividends Declared

Last week the board of directors of Public Service Corporation of New Jersey declared a quarterly dividend of 65 cents a share on the common stock payable March 31 to stockholders of record as of March 1, placing the stock on an annual dividend basis of $2.60 per share. Quarterly dividends were also declared on the corporation's preferred stock, also payable March 31 to stockholders of record as of March 1. The dividends are:

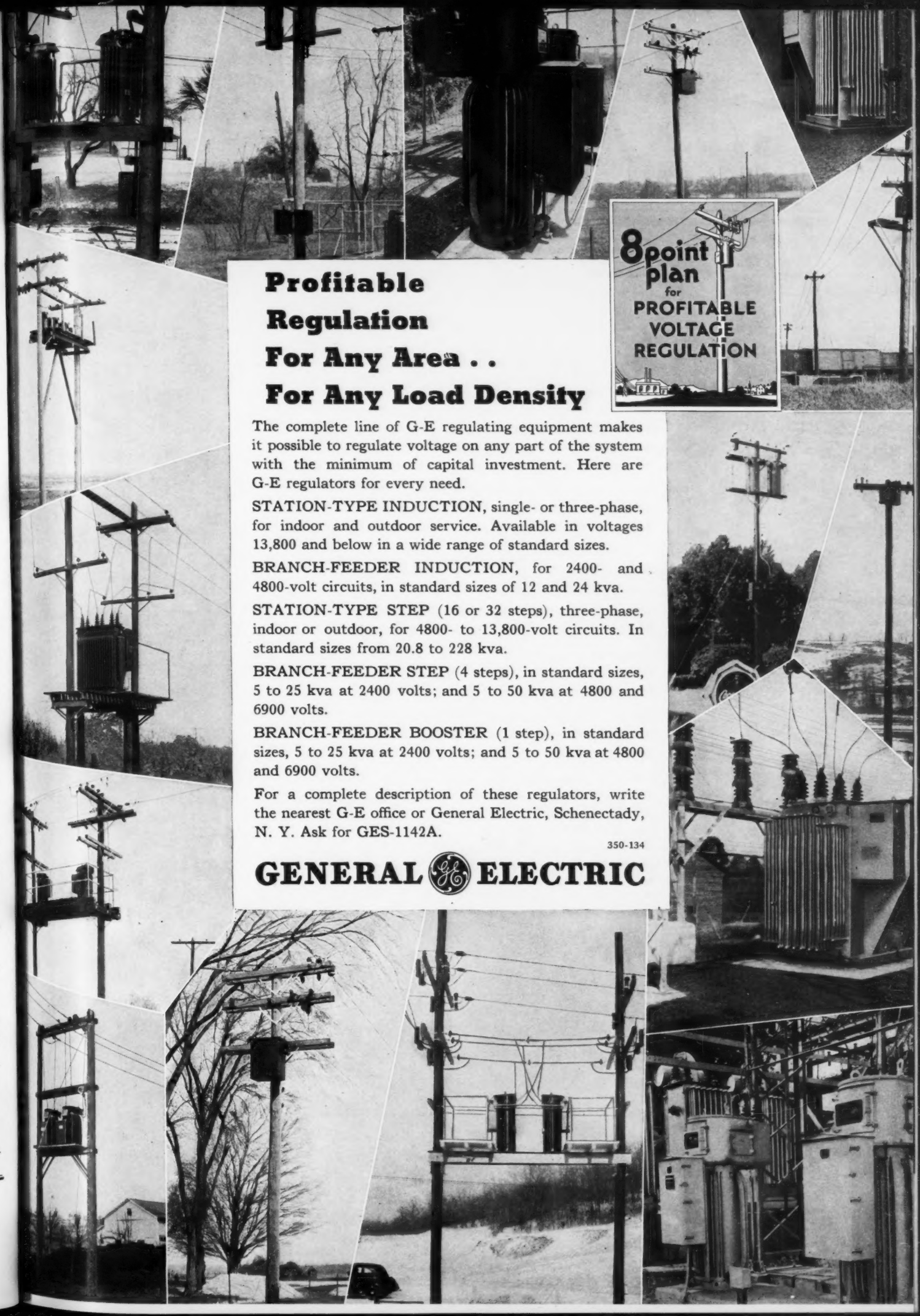
$2 per share on the 8 per cent cumulative preferred stock; $1.75 on the 7 per cent cumulative preferred stock and $1.25 on the no-par value $5 cumulative preferred stock. Regular monthly dividends of 50 cents a share were also declared on the 6 per cent cumulative preferred stock, payable February 27 to stockholders of record February 1, and March 31 to stockholders of record March 1.

At a meeting of the board of directors of Lexington Utilities Company a quarterly dividend of $1.62½ per share was declared on the preferred stock, payable February 10 to stockholders of record at the close of business on January 30. A dividend of 50 cents per share was also declared on the preferred stock as a payment on the dividend accumulations in arrears on the stock, payable February 10 to stockholders of record at the close of business January 30.

This week the Consolidated Edison Company of New York declared a dividend of 50 cents on the common, payable March 15. On December 15, last, the company paid 25 cents extra in addition to a dividend of 50 cents.

New Issues of Electric Light and Power Securities in January

Name of Company	Amount (Par value)	Offered to	Period	Class	Purpose	Interest Rate	Price	Per Cent Yield
Consumers Power Co	$55,052,694	Public	.....	Preferred stock	To retire 6, 6.6 and 7% preferred stock.	$4.50	$100.50	4.477
City of Los Angeles Dept. of Water and Power.	$23,500,000	Public	1-40	Revenue bonds, series A.	Proceeds will be used to acquire the electric properties of the Los Angeles Gas & Electric Corp. and to link them with the city plant.	3½	102.48 to 102.25	1.00 to 3.40
	23,500,000	Public	40	Revenue bonds, series B.		3½	102	3.41
Total	$102,052,694							



Profitable Regulation For Any Area . . For Any Load Density

The complete line of G-E regulating equipment makes it possible to regulate voltage on any part of the system with the minimum of capital investment. Here are G-E regulators for every need.

STATION-TYPE INDUCTION, single- or three-phase, for indoor and outdoor service. Available in voltages 13,800 and below in a wide range of standard sizes.

BRANCH-FEEDER INDUCTION, for 2400- and 4800-volt circuits, in standard sizes of 12 and 24 kva.

STATION-TYPE STEP (16 or 32 steps), three-phase, indoor or outdoor, for 4800- to 13,800-volt circuits. In standard sizes from 20.8 to 228 kva.

BRANCH-FEEDER STEP (4 steps), in standard sizes, 5 to 25 kva at 2400 volts; and 5 to 50 kva at 4800 and 6900 volts.

BRANCH-FEEDER BOOSTER (1 step), in standard sizes, 5 to 25 kva at 2400 volts; and 5 to 50 kva at 4800 and 6900 volts.

For a complete description of these regulators, write the nearest G-E office or General Electric, Schenectady, N. Y. Ask for GES-1142A.

350-134

GENERAL ELECTRIC

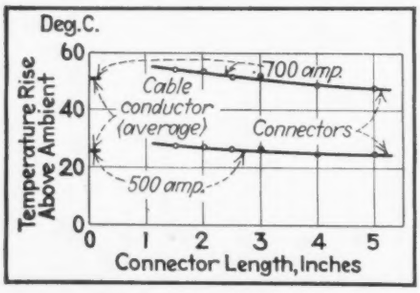
Field OPERATING PRACTICES

New ideas and practices in the operation of well-designed, constructed and maintained plants and systems

Joint Rise Affected by Connector Length

By HERMAN HALPERIN
and
R. J. PATTERSON
Commonwealth Edison Company, Chicago

At load currents of 500 and 700 amp. differences were small between temperature rises on 1½- and 5-in. connectors installed on 500,000- circ.mil, 500-volt cable. For example, the difference at 700 amp. was only 6



Small differences in joint heating—Temperature rises of 500,000-circ.mil cable conductor and of 500,000-circ. mil connectors of various lengths in low-voltage joints

deg. C., or 11 per cent. Calculations indicated that most of these differences were due to the greater heat radiation from the longer joint sleeves used for the longer connectors. This interesting result was obtained from tests made by the Commonwealth Edison Company to determine the temperature rise of straight split copper connectors of various lengths when carrying heavy load currents. The typical conductor size, 500,000 circ.-mil, was selected and tests made with connectors installed on bare conductor and in standard joints on 500-volt and 35-kv. single-conductor, paper-insulated, lead-covered cable. For the tests involving cable, thermocouples were used in order to measure temperatures at cable conductor and sheath, and at various points throughout the joints.

The temperature rises of the connectors were of the same order of magnitude as of the insulated cable conductor. Even for the 1½-in. connector at 700 amp., with a surface current density of 360 amp. per square inch, the ultimate temperature of the connector and adjacent varnished cambric tape insulation was less than 75 deg. C., which is the A.I.E.E. limiting temperature of varnished cambric cables.

The workmanship in installing connectors in these tests was first grade, as shown by examination and by resistance measurements. A study of the quality of connector workmanship found in joints removed from service indicated that reasonably good workmanship is normally obtained. For field work, therefore, a surface current density of two-thirds of the laboratory value, or about 250 amp. per square inch, should prove adequate. This would require, for example, for 500,000 and 2,000,000 circ.mil, 500-volt cables on the Chicago system connector lengths of about 2 in. and 2½ in., respectively, as compared with N.E.L.A. standard lengths of 3 in. and 6 in. It thus appears that, thermally, N.E.L.A. connectors would be quite satisfactory. For conductor sizes of 1,000,000 circ.-mil and larger connectors considerably shorter than the N.E.L.A. designs could be safely used.

Strong Conductor Cuts Street Light Costs

By MALCOLM M. BRIDGWATER
General Superintendent
Arizona Power Corporation, Prescott

Prescott, Ariz., has the distinction of being the first city in the state to make an installation of sodium vapor lights. The Arizona Power Corporation and the city entered into a contract whereby the power company installed ten sodium vapor lights along Highway 89 from its south entrance to the city to the beginning of the white way system. The entire route along

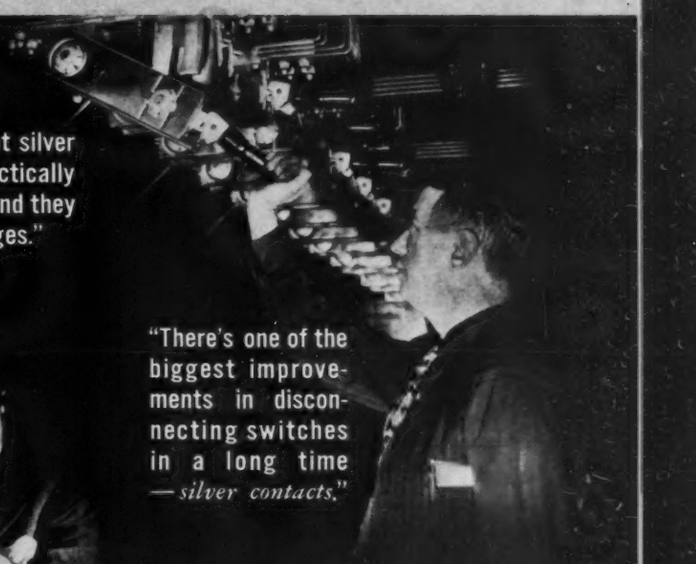
Modified rural construction and high-strength conductor save street-lighting installation costs

The Trend Is Unmistakable

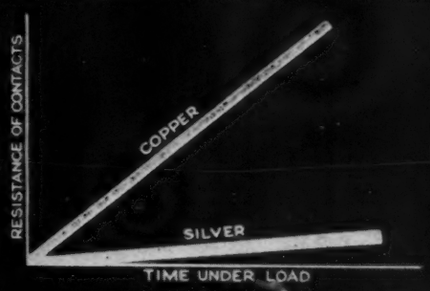
–switchgear with SILVER contacts that stay cool and save your maintenance money

"I tell you, these big G-E switches operate a lot easier with silver line contacts."

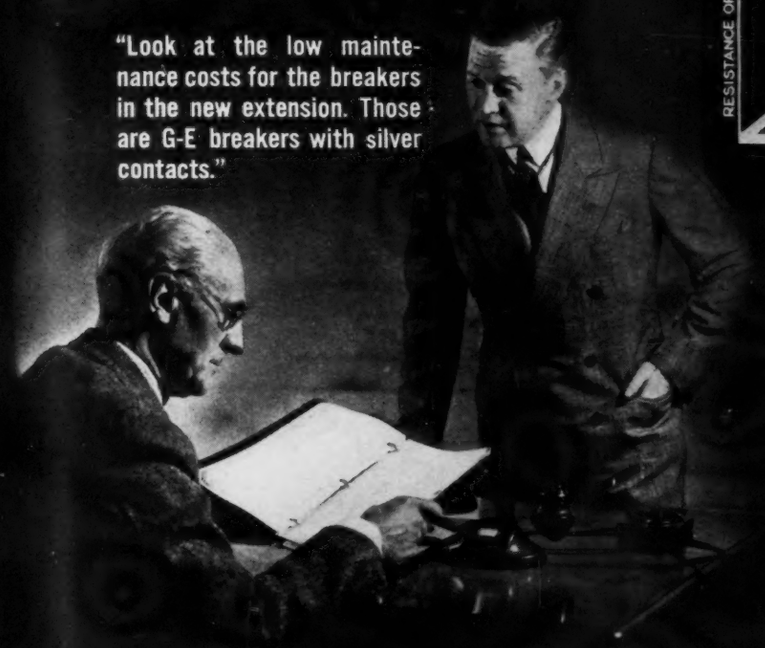
"That's right—you get silver contacts now on practically all G-E switchgear—and they have lots of advantages."



"There's one of the biggest improvements in disconnecting switches in a long time —*silver contacts.*"



"Look at the low maintenance costs for the breakers in the new extension. Those are G-E breakers with silver contacts."



"See the difference! Practically no increase in the resistance of *silver* contacts. That's why they stay so cool."

890-23

GENERAL ELECTRIC

which these lights were installed is along a residential street with a few scattered neighborhood stores.

The sodium vapor luminaires were spaced 250 ft. apart, installed on 35-ft. wooden poles and staggered on either side of the street. To present as neat an appearance as possible along this residential street and to make an economical installation, it was found desirable to use an absolute minimum number of poles. By using No. 6A bare Copperweld copper conductors, it was possible to eliminate intermediate poles.

The high strength gave excellent ground clearance on 250-ft. spans when strung on the 35-ft. poles. Further to make this installation as inconspicuous as possible a modified type of rural construction was used, which added greatly to the appearance of the installation.

This construction resulted in a sightly street-lighting installation at a substantial saving in installation cost. It met with the enthusiastic approval of the residents of the street, with the result that the City Council authorized two additional installations, which brings the total of sodium vapor luminaires to 25 installed on three main highways in the city.

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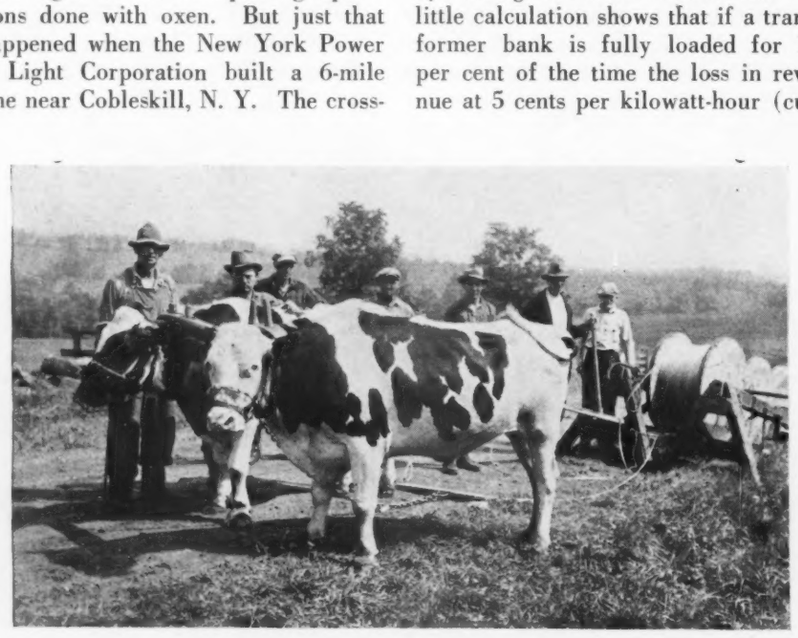
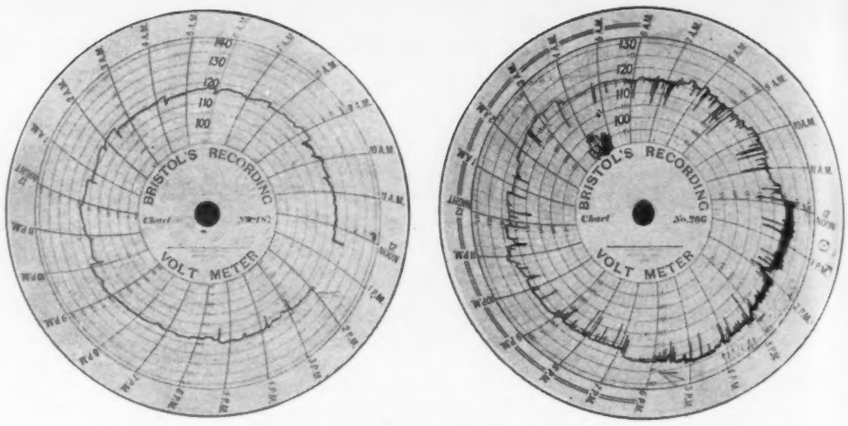
Sad Oxen Serve Their Coming Doom

In these days of tractors and other automatic equipment it is an uncommon sight to see wire-pulling operations done with oxen. But just that happened when the New York Power & Light Corporation built a 6-mile line near Cobleskill, N. Y. The cross-country lines extended through planted patches, orchards, corn and buckwheat fields. Horses were not available, but oxen were. They carried out the wire as fast as a team of horses would, and with little damage to the crops. The linemen say they did the job with a good steady pull and better than a team of horses.



Old farm power aids in bringing new



A smoother voltage curve

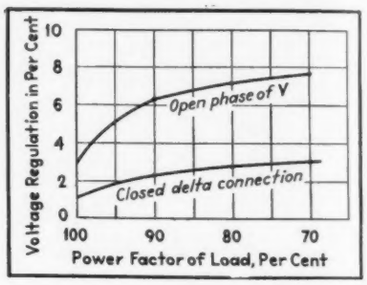
The chart on the left shows the effect of closing the delta on an 87-kva. load that was served by two 50-kva. transformers.

•

Open Delta Makes for Poor Regulation

By B. E. ELLSWORTH
Engineer Iowa-Nebraska Light & Power Company, Lincoln, Neb.

Open delta transformer banks have been popular with operating men for years, due to the fact that the original cost of the transformers is low and load increase can easily be cared for by adding the third transformer. A little calculation shows that if a transformer bank is fully loaded for 10 per cent of the time the loss in revenue at 5 cents per kilowatt-hour (customer's cost) will pay for the third transformer (and losses) in approximately 3½ years, due to higher voltage secured during this 10 per cent of the time.



Closing the delta improves regulation

The open delta consists of two 50-kva. transformers with a balanced full load of 87 kva. Adding the third transformer results in the much better regulation of the lower curve for the same load.

More and more attention is being given to maintaining proper voltage at the customer's meter under all load conditions. This is made extremely difficult when open delta banks are used in substations and distribution systems. Two open delta banks in series with the open phases common may produce as high as 15 per cent voltage drop under full load conditions. Phase voltages will not only be low but badly unbalanced. Many times these poor voltages are blamed on the distribution system, when they are really due to the transformer connection.

The accompanying curve gives the voltage regulation on the open phase of a "V"-connected bank and on the same bank with the third transformer added to form a closed delta, under the same load conditions. The voltage charts were taken at a substation before and after closing the delta of the substation bank.

FIGURE ON SAVINGS WITH THIS IMPROVED LINE WIRE

Savings in maintenance . . . by lessening the number of interruptions . . . by cutting down on repair bills . . . as well as improving continuity of service. A strong, light, long-life wire, with an improved covering.

1 Copper Conductor

Can be either solid or stranded, soft-, medium- or hard-drawn as service conditions demand. Medium-hard-drawn is standard.

2 Varnished Cloth

Wraps of varnished-cambric tape, of identically the same high quality as used in the construction of G-E varnished-cambric power cable. It does not readily absorb moisture and has high-dielectric-strength and long-life qualities.

3 Weatherproof Finish

Heavy, closely woven braid, treated with high-melting-point U.R.C. Compound. Continued and varied service has proved that it is the most weather-resisting finish of its kind. Further protected by mica dust, which prevents layers of wire from sticking when coiled and provides a smooth surface that sheds water.

YOU can use this VC line wire for the same applications as ordinary braided weatherproof wire—for overhead distribution, primary and secondary circuits. It is superior in having a higher voltage-test strength, is more effective in preventing arcing if two wires swing together; and is in addition tougher, more weather-resistant, and longer-lived.

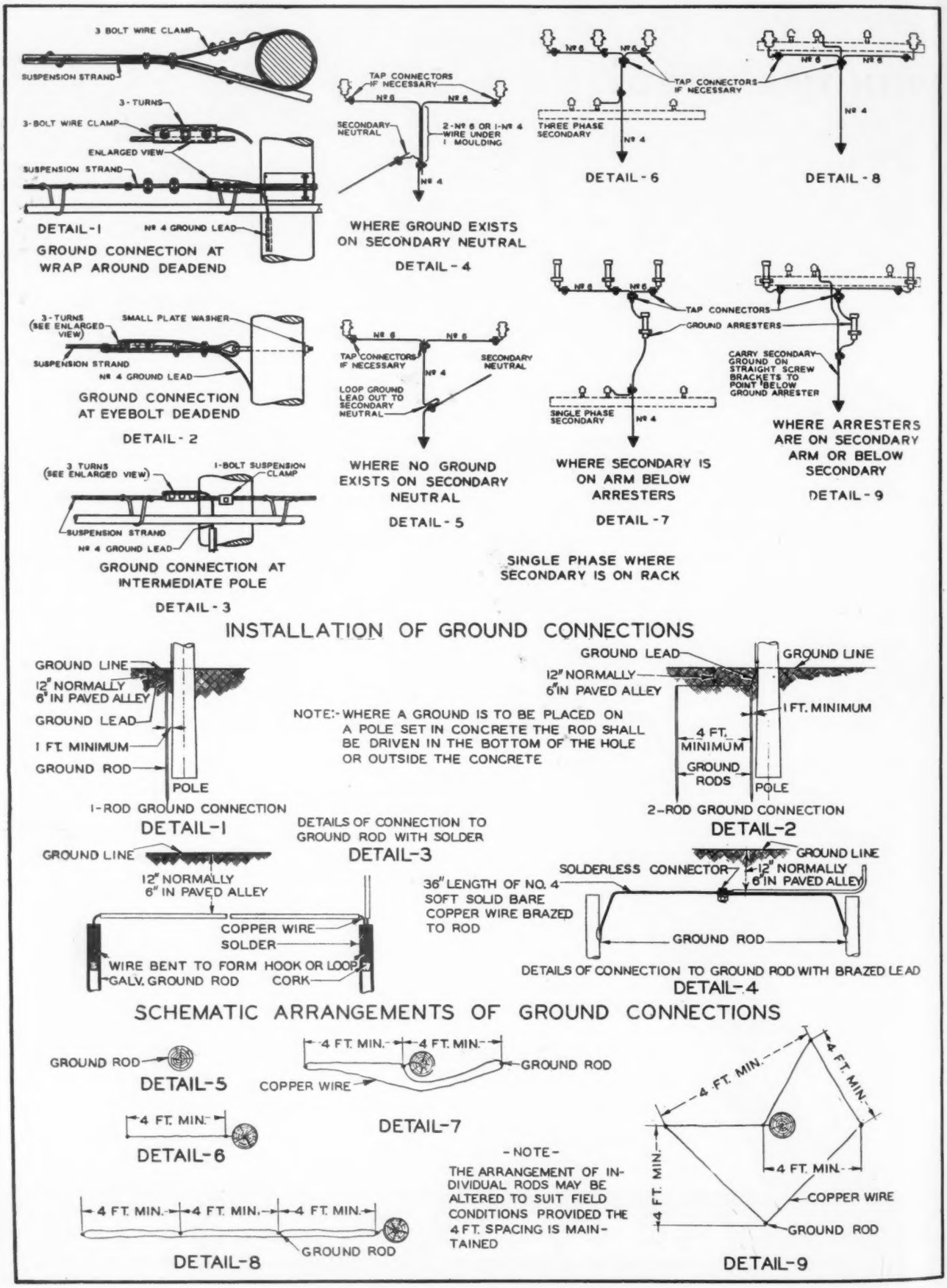
You can see how this wire minimizes the possibility of fuse outages and transformer failures; how it reduces impedance and thus improves regulation and enables you to give better service.

VC line wire is available in all standard sizes, from No. 20 Awg to 2,000,000 cir mils—many of which are carried in stock. May we give you prices and further information? Address nearest G-E sales office, or General Electric, Dept. 6A-201, Schenectady, N. Y.

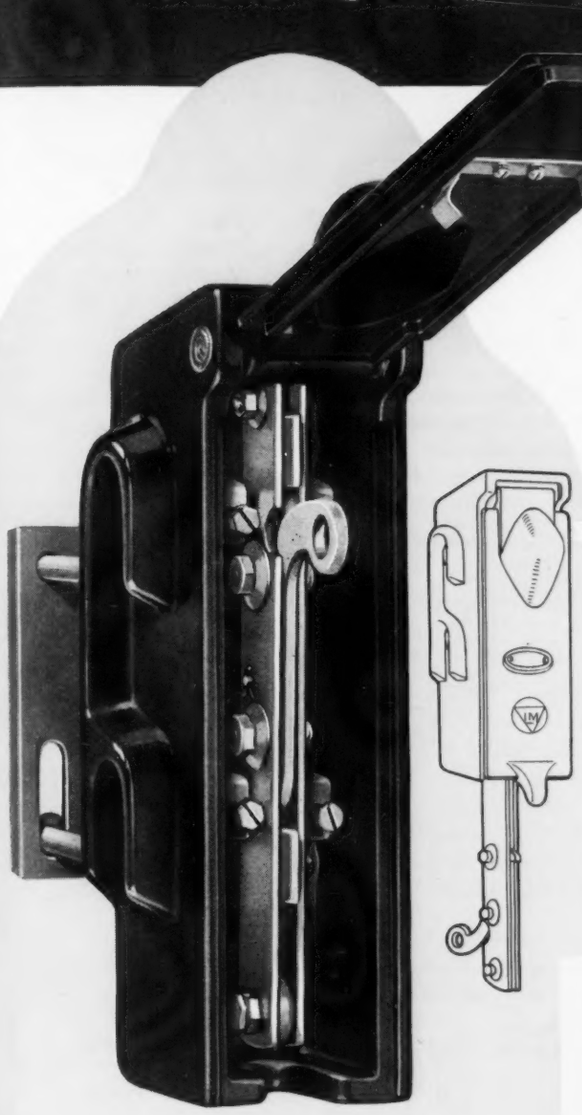
520-108

GENERAL ELECTRIC

Standard Grounding Methods Used by Detroit Edison Company



Another PORCELAIN HOUSED L-M DISCONNECT SWITCH *with Features You will Like*



7500 V, 400 A

Swift action . . . safe, convenient operation . . . long, dependable service . . . you get them all in this new design L-M Disconnect Switch. Here are a few of the features you'll like:

"Dead Hinge" type blade for safety.

Large Pull Ring for easy operation.

Cam Action Blade for quick action.

Full Floating Clamp Type Terminals with slotted hex heads fitted by screw driver or socket wrench.

Snug-fitting Bakelite door stays closed with blade in open or closed position.

Adjustable Cross Arm Hanger.

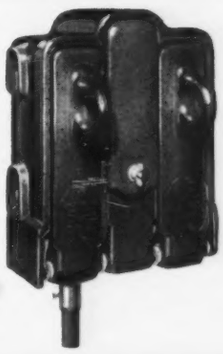
. . . . The Catalog Number is C-353003-1. Ask your L-M representative about these switches, or write to Line Material Co., South Milwaukee, Wisconsin. See other Disconnect Switches in your L-M Catalog.

Two L-M Fuse Cutouts

Built to Protect

Type "PVD"
Drop-out Fuse Cutout — 5000 and 7500/125000 V, 60 and 150 Amperes.

Type "RP"
Reclosing Fuse Cutout — with Built-in Time Delay 5000 Volts, 50 Amperes.



LINE MATERIAL CO.

Building Up THE LOAD

New ideas and practices in selling electrical equipment and service to commercial and domestic customers

Electric Cookery Doubles Energy Use

Installation of electric cooking and heating equipment in an Eastern college has practically doubled its energy consumption—measured over a five-month period—since 1934. In that year the college used coal, gas and steam for cooking, except for a 7,200-watt Talbot electric grill. The load then supplied by the utility serving the college was 95 per cent lighting and 5 per cent miscellaneous power and refrigeration. The college used 141,000 kw.-hr. from January to May, 1934, inclusive, with fifteen-minute demands ranging from 64 to 120 kw.

In December, 1934, a new building was completed and early in January, 1935, the first meal was served from the new kitchen. Installed load in this dining room and auxiliary quarters totaled 40 kw. in lighting, 84.6 hp. in motors and 250.3 kw. in electric cooking and heating equipment. The corresponding five-month usage for 1935 totaled 248,200 kw.-hr., with an average fifteen-minute demand of 115 kw.

The energy requirements per meal —300 are served each day of term time—average as follows for this dining hall:

	Watt-Hours per Meal
Dining hall, all power and heating	260
Kitchen and bakery, power, heating and refrigeration	234
Kitchen and bakery, power and heating	211
Kitchen and bakery, heating only	183
Kitchen, heating only	111

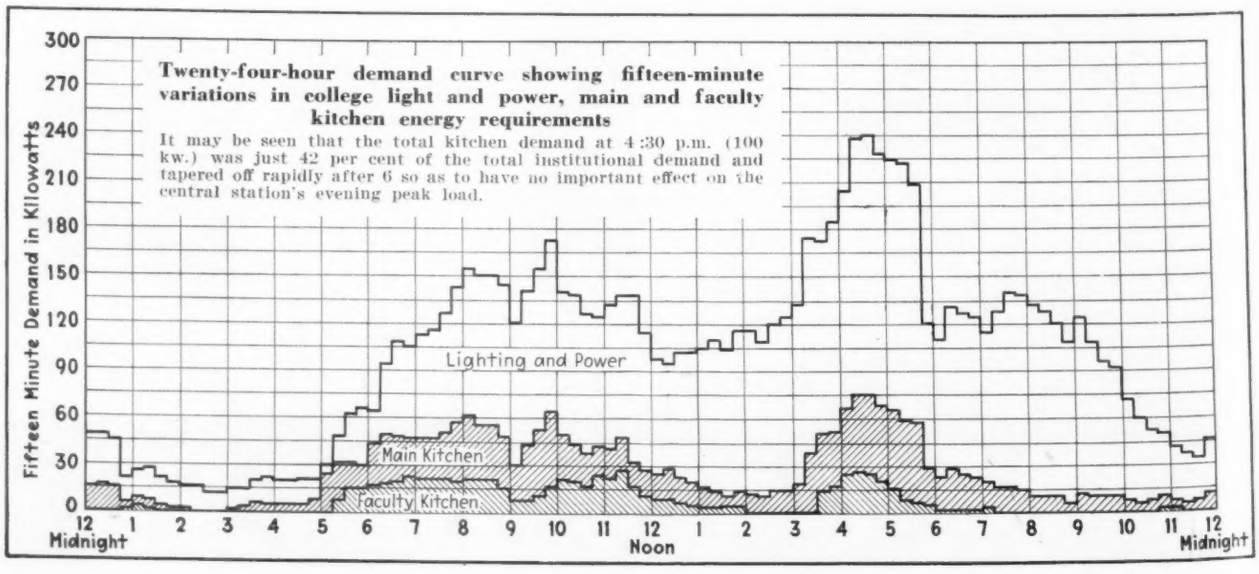
In the first five months of 1936 a second electric kitchen was installed for faculty service and this added 9.5 hp. in motor load and 58.6 kw. in heating. The college's total consumption for these five months gained 26,680 kw.-hr. over the previous year, with an added average fifteen-minute demand of 35 kw. The average consumption per meal in this second kitchen was 640 watt-hours for all power and heating and 526 watt-hours for heating only.

•

Lottery Stimulates Refrigerator Sales

An unusual and effective method of stimulating electric refrigerator sales during certain months of the year was tried out by the electrical dealers in Sacramento, Calif. Dealers who participated in the sales campaign purchased tickets for $1 each, the fund thus raised being used to offset the cost of the award.

Customers who purchased a refrigerator from any one of that group of dealers were given one ticket or chance in the lottery which was held at the end of the month. At that time



Twenty-four-hour demand curve showing fifteen-minute variations in college light and power, main and faculty kitchen energy requirements

It may be seen that the total kitchen demand at 4:30 p.m. (100 kw.) was just 42 per cent of the total institutional demand and tapered off rapidly after 6 so as to have no important effect on the central station's evening peak load.

TO DEMONSTRATE LIGHTING—Finished in antique English oak and illustrating solid comfort in furnishing and appointments, this demonstration dining room at the main office of the Western Massachusetts Electric Company in Greenfield is an aid to the sale of electric service in the home in the central Connecticut Valley. Several methods of lighting can be demonstrated, including wall brackets, luminaire and coves provided with colored lamps wired to reveal the effect of different tones. The company does not directly merchandise appliances, but encourages local dealers to utilize its demonstration facilities freely. Incidentally, the dining room as well as the rest of the office building is heated by water circulation from dump hydro-electric energy which would otherwise be wasted at the generating units of the company on nearby streams

the stubs for the tickets were collected and a drawing held. The customer holding the ticket number corresponding to the stub drawn from the lottery was given his refrigerator free, reimbursement being made if cash had been paid for the box or the paid-up contract given to the winner if it was purchased on time. Thus one customer during the month obtained an electrical refrigerator without cost and each dealer contributed to the expense of the lottery in proportion to the number of refrigerators sold by him during the month.

•

Test Efficiency of Dairy Water Heaters

By J. M. FORE
Assistant, Agricultural Engineering Department, Purdue University*

Early types of electric water heaters for dairy use were not very practical due to inadequate insulation, high wattages and uncontrolled heat. Experimental work on heaters of this type was started at Purdue Experimental Station in 1931 and is an active project at the present time. Tests were made on each new type as it was put on the market and a comparison of the figures on efficiencies will indicate the improvements made.

The first study was on a non-pressure type dairy water heater with insulated tank of 8 gal. capacity. This unit is provided with a 500-watt, 110-volt heating unit, thermostatically controlled. Maximum setting of the thermostat was 170 deg. F., high enough for hot water to cleanse utensils. An average of three tests in heating water from tap temperature to 156 deg. F. showed this heater to have an efficiency of 85.2 per cent. Records obtained for an 89-day period showed an average efficiency of only 64.0 per cent to heat 1,454 gal. of water from tap temperature to 170 deg. F. and maintain it at that temperature. Cost of heating water under these field conditions would be 1.35 cents per gallon at a rate of 3 cents per kilowatt-hour.

The second heater tested was an immersion type, of 1,250-watt capacity for 110-volt current, to be used in an ordinary 10- or 12-qt. pail. An average efficiency for three trials of 76.7 per cent was obtained where 2.9 gal. of water was heated in a 12-qt. galvanized bucket from 75 to 170 deg. F. Records kept during a 34-day period showed that at a 3-cent rate the cost per gallon for heating was 1.13 cents, even though the temperature increase in the case of the immersion heater was 133 deg. and only 118 deg. with the other heater.

Laboratory tests of 5-kw. and 1-kw. heaters indicated efficiencies comparable to heaters of much smaller wattages and capacities. The 5-kw. heater with a tank capacity of 15 gal. required 7.3 kw.-hr. in 90 minutes to raise the temperature from 65 to 212 deg. The efficiency was 73.7 per cent. The 1,000-watt heater with a tank capacity of 15 gal. required 5.4 kw.-hr. in 360 minutes to raise the temperature from 79 to 203 deg. The efficiency was 84 per cent. This heater has been used three years and was recently rebuilt, insulating with new rock-wool and installing a new thermostat and heating element.

*From talk at Rural Electrification Conference, Purdue University.

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Still Good Rules for Selling Power

Back in the days before he became E. W. Lloyd, vice-president in charge of sales, Commonwealth Edison Company, Ed Lloyd, the hustling "general contract agent" of the Chicago Edison Company, wrote a little book, "Notes on the Sale of Electric Power." At the conclusion of the treatise—dated 1906, thirty years ago—are some bits of advice for contract agents, *i.e.*, power salesmen of that day. This advice is so pertinent to the problems of today that we quote some of it here:

After all your work has been done in connection with the obtaining of a customer and the power is being furnished from the system your work is still not completed. The customer must be watched closely.

He should be visited by the agent who handled the contract, his acquaintance cultivated and his wants attended to; you will then hear less about putting in a plant.

When a customer complains that his bills are increasing with no more factory output, do not be satisfied that he does not know what he is talking about, even after you have found his meter registering correctly.

The complaint cannot be too carefully investigated, as nothing irritates a customer more than to tell him in a cold-blooded manner that his meter has been tested and is registering correctly and there is no further remedy.

In other words, put yourself in his place with comparatively small knowledge of electric power.

It is fully as important to keep customers as to get them, if not more so.

You cannot treat the public too well. Good treatment pays the best dividends.

Industrial ELECTRIFICATION

New ideas and practices in industrial electrification as presented by industrial, consulting and power sales engineers

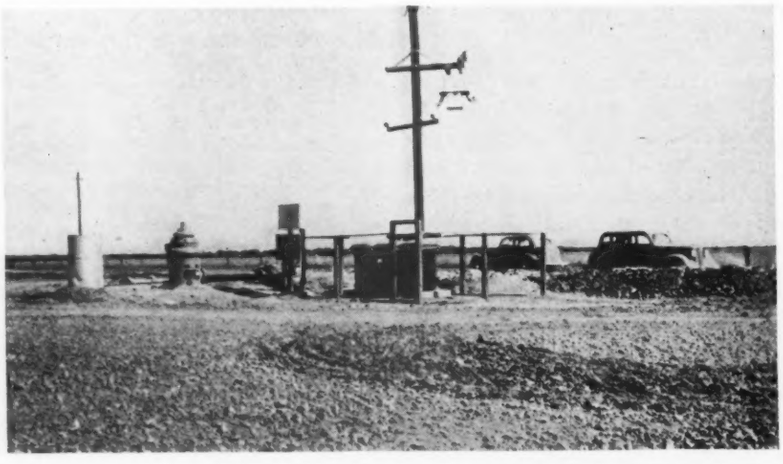
Outdoor Motors Restore Arid Acres

Fifteen 100-hp. electrified irrigation pumps are converting 10,000 arid acres of the Arizona Farm Products Corporation into fertile farms suitable for raising and harvesting 7-ft. high, long staple cotton in a single season. Power is supplied by the Salt River Valley Water Users Association to 100-hp., three-phase, 440-volt, 1,450-r.p.m., 25-cycle Westinghouse hollow-shaft vertical motors driving vertical Pomona turbine pumps equipped with water-lubricated rubber bearings. Each pump has a capacity of 2,500 g.p.m., delivering a total of 3,600,000 gal. of water and consuming 2,004 kw.-hr. per day.

Each pumping station is supplied by a simple outdoor 6,600/440-volt substation consisting of three 37½-kva. transformers mounted on a concrete foundation, with the necessary outdoor protective devices, safety features, lightning arresters. The substations average approximately ½ mile apart and were constructed for approximately $2,500 each. The wells are 450 ft. deep, 20 in. in diameter, water rising to within 120 ft. of the surface, with a total lift of approximately 140 ft.

The majority of this tract is one large farm, with electricity used for cooking and heating; it is the largest new development of its kind in the Elroy district since formed in 1930 under the Arizona law.

Fifteen simple 6,600/440-volt outdoor substations supply power to a total of 1,500 hp. in outdoor irrigation pumps that are restoring fertility to 10,000 arid acres



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Capacitor in Mine Yields 70% Return

With the revival of gold mining in California has come extensive electrical modernization, resulting in greater production and increased efficiency. Indicative of the benefits of this new equipment are the savings effected by the Empire-Star Mines Company, Ltd. with the installation by General Electric Company of capacitors for power-factor improvement totaling 1,875 kva.

Empire-Star mines have been in operation since 1850. Prior to the present modernization the company's two largest mines, the Empire and the North Star, were consuming purchased energy at 77 per cent power factor. Both operated under a Pacific Gas & Electric Company rate which carried a penalty and bonus of 0.25 per cent of the power bill for each per cent of power factor under or over 85. In these two mines 1,480 kva. of rack-type capacitor units were installed; thirteen were 100 kva., 400 volts, and one was 180 kva., 2,300 volts.

The raising of power factor from 77 to 97 per cent effected a 5 per cent saving on the power bill, amounting to $7,300 per year. In addition, the capacitors decreased transformer and feeder losses and released capacity in transformers amounting to 600 kva. These advantages, together with improved voltage regulation, place the annual saving, conservatively estimated, at $10,000. This, on a $14,000

How much are "OUTAGES" costing you?

Running Meters mean Revenue . . . Service Calls are an Expense!

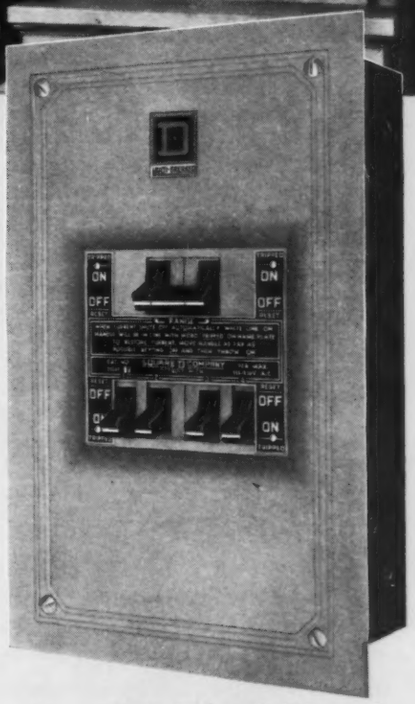
the SQUARE D MULTI-BREAKER Eliminates Fuse Blow-Outs

Every time a fuse blows, the current stops flowing through that circuit, until service is restored. It may be only a few minutes before the fuse is replaced—it may mean a service call and several hours delay. In any case, it means a loss of revenue.

Individually these "outages" are unimportant, but collectively they represent a substantial amount that could be saved by the power companies if the Square D Multi-breakeR was already in universal use.

The Square D Multi-breakeR eliminates fuses and provides circuit breaker protection. Current can be restored by the flip of a lever—provided danger no longer exists—and most blown fuses are caused by troubles of a temporary nature.

Power companies should encourage the installation of Square D Multi-breakeRs on their lines—both for new services and for change-overs made necessary by the addition of electric ranges or water heaters. The cost of a Multi-breakeR is little more than entrance switch and fuse cabinet.



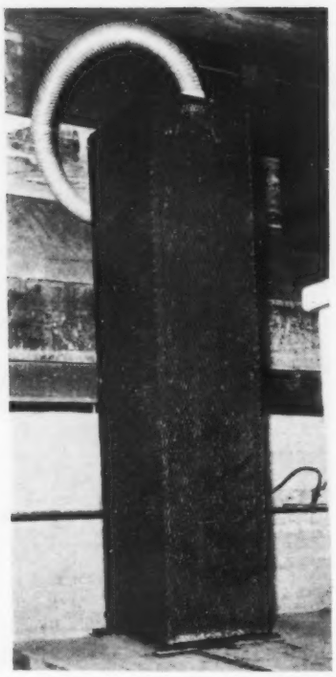
Square D Multi-breakeR is made for either flush or wall mounting in capacities up to 50 amperes.

SQUARE D COMPANY

DETROIT - MILWAUKEE - LOS ANGELES

SQUARE D COMPANY CANADA LTD. TORONTO, ONTARIO

CALL IN A SQUARE D MAN



Fourteen effected a $7,300 saving

investment in capacitors, represents a return of 70 per cent.

Other phases of the modernization at North Star mine included electrification of the 500-hp. hoist at the vertical shaft, electrically driven pumps, new electrically driven milling equipment and installation of transformers at the 2,000-ft. level. The latter, installed by General Electric to meet the demand for fireproof equipment below ground, were Pyranol filled. Three in number, they are rated 4,000-11,000 volts 150 kva.

•

Tips on Selecting Service Equipment

In determining the size of service conductors and the capacity of service equipment (switch and fuses or circuit breaker) to be used in the electrical installation for commercial buildings and industrial power plants the first step is to compute the total initial load by totaling the feeder loads. These, according to a summary of standard wiring design practice in *Electrical Contracting*, Vol. 35, No. 8, should be the loads computed for the various feeders before any permissible demand factors less than 100 per cent have been applied. Any power load should be segregated. "Power load" is any load, motors or electrically heated equipment not supplied by "15-amp." or "appliance" branch circuits as defined in the National Electrical Code. Demand factors permitted by the code should be applied to the total load other than power load. In most cases no demand factor less than 100 per cent should be applied to the power load.

Provision for increases in service capacity should not be overlooked. The *original* installation should include service-entrance conductors and service equipment having the required excess capacity in *every* case where the rating of equipment will not exceed 400 amp. For any given initial load, size of conductors and rating of service switches and fuse or circuit breakers may be taken from the accompanying table if an increase of 50 per cent is to be provided for.

Where calculated future loads exceed 400 amp. an individual study should be made of each case. The following considerations should be given due weight: (a) Any building having an expectant life of ten years or more will probably need added service capacity. (b) In most cases added capacity can be provided only by tearing out and replacing the original service conductors and service equipment; the larger the service the greater the expense. (c) Considerable additional expense is involved in providing 50 per cent excess capacity in the case of a heavy service, and this is a non-productive investment until some part of the excess capacity is utilized.

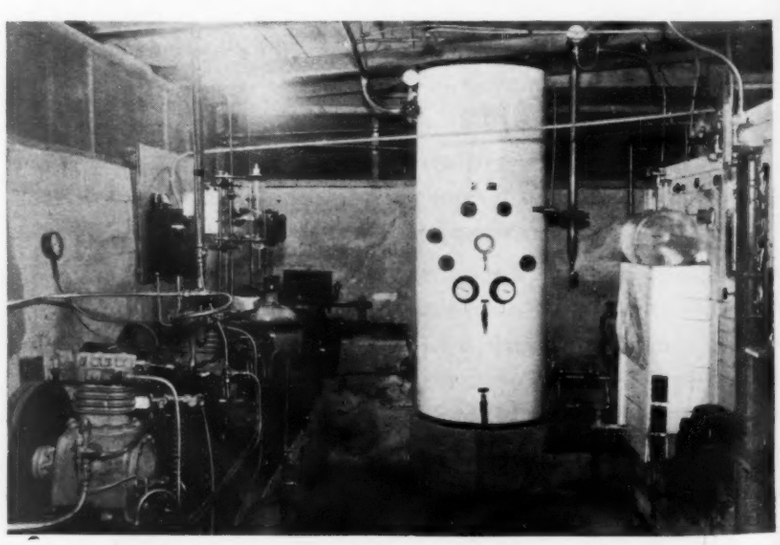
Service Switch and Wire Sizes

Initial Load, Amp.	Service Switch, Amp.	Wire Size
1– 23	60	8
24– 33	60	6
34– 47	100	4
48– 60	100	2
61– 67	100	1
68– 83	200	0
84–100	200	00
101–117	200	000
118–133	200	0000
134–150	400	0000
		Circ. mil.
151–167	400	250,000
168–183	400	300,000
184–200	400	350,000
201–217	400	400,000
218–267	400	500,000

•

Gland Serum Produced at 40 Below

Many industrial processes require sub-zero temperatures for their operations. Recently Frigidaire engineers were called upon to provide a temperature of 40 deg. below zero continuously for the manufacture of a serum in a California sanitarium. Two standard compressors operating in conjunction with a condenser of a special design and a heat interchanger were installed. The process involves distillation and condensation of the extract of steer supernal glands at this low temperature as well as refrigerated storage for glands awaiting processing. The compactness of the installation is typical of modern equipment for industrial use.



Serum produced from supernal glands at low sustained temperature

WAGNER Rural-Line Distribution Transformers

TYPE HEB-F

For operation on solidly-grounded common neutral systems

- Reduce rural-line costs
- Economical to install
- Economical in operation
- Easy to mount
- Adequate protection against lightning

Wagner type HEB-F rural-line distribution transformers meet the need for a small inexpensive unit designed for application to lines of 13,200 Y volts and below. Some of the advantages of Wagner rural-line transformers are:

1. Cost is reasonable, yet consistent with good operating economy.
2. Design is adaptable to any kind of system or type of line service.
3. They are self-protecting against lightning.
4. Bushings, mounting brackets, gaps, connectors, etc., are so arranged as to facilitate installation and maintenance.
5. Their operating efficiencies are within prescribed limits for economical performance.
6. Construction is representative of the latest development in design and manufacture.

If you want more details about Wagner transformers that are especially designed for rural electrification service, write for the Wagner Bulletin Form S488. TD237-1B

Wagner Electric Corporation

6400 Plymouth Avenue, Saint Louis, U.S.A.

MOTORS • TRANSFORMERS • FANS • BRAKES

New ENGINEERING IDEAS

Discoveries, proposals and developments by electrical engineers and scientists in the field, the factory and the laboratory

Automatic Operation in Heat Treatment

By MARCUS A. GROSSMAN
Director of Research
Carnegie-Illinois Steel Corporation, Chicago*

Equipment used in heat treating alloy bar stock by the Carnegie-Illinois Steel Corporation consists in essence of two bell-type electric heating furnaces and one quenching tank, all large enough to handle bars up to 30 ft. in length. The outstanding feature of the equipment is the uniformity obtained in the heat-treating operations. This uniformity is promoted on the one hand by the design of the two electric furnaces for uniform heating and, on the other hand, by the automatic timing of the crane motion and of the quenching operation.

Each furnace consists of a car bottom, upon which a rectangular bell-type heating chamber descends when the furnace is in use. The car bottom is so arranged that the load of bars rests on elevated racks of heat-resistant alloy. The bell-type heating chamber descends and rests on this car, the whole being closed by an oil or sand seal. The heating elements are in the bell-type cover, and are so placed on the sides and roof as to give uniform heating of the load.

When the load is ready for quenching and tempering these operations are then carried out almost entirely automatically. That is to say, the bell is raised and the subsequent operations are carried out automatically by proper setting of the electrical equipment: Pulling out the furnace car, raising the load by means of the crane, moving the crane over the quenching tank, quenching the steel for a predetermined number of seconds or minutes and transferring the quenched steel to the car of the tempering furnace. The tempering furnace has already been brought to temperature, the car is moved into the furnace, the bell is lowered and the tempering operation is carried out immediately.

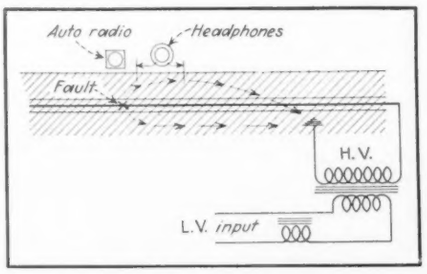
* From paper to Association of Iron and Steel Engineers.

•

Scheme Finds Faults in Non-Leaded Cable

By RAYMOND F. STAINBACK
University of North Carolina,
Chapel Hill, N. C.

In finding insulation faults in underground cables without lead sheaths, it is usually difficult to use the "woodpecker" or resistance bridge, or any of the similar methods which might be used with the lead-covered cable, because of the high resistance of the fault when not actually arcing, and the impracticability of melting or burning the materials at the fault to form a dead short.



Simple scheme locates faults in non-leaded cables

When the fault is reached a very considerable disturbance will be heard in the radio. The fault can be located within a few feet by this means.

In such cases the cable can be cleared and a high voltage applied from a small power transformer or a potential transformer of suitable voltage to cause an arc at the fault between the conductors and ground or between two conductors in the same cable. The transformer supplying the high voltage is protected by a current-limiting reactance or resistance in the primary circuit to prevent excessive currents at the time of formation of the arc. The primary of another transformer of similar voltage rating may be used as the current-limiting reactance, but better results will be obtained if a resistance or reactance which will allow more current is used. If the arc is formed to ground it is often possible and practicable to locate the fault by means of a pair of headphones connected to two electrodes driven in the ground along the path taken by the cable.

An alternate and more suitable detector is a radio carried along the path taken by the cable, particularly if an automobile containing a radio can be driven along, over or near it.

•

Quick Megger Check

Not for calibration, but merely for a rough check for assurance that the instrument has not suffered from the casual handling that a megger commonly receives, there has been assembled in the meter laboratory of Dallas (Tex.) Power & Light Company a handy megger-checking device.

As shown in the accompanying sketch, it consists of a number of radio resistors mounted on a piece of bakelite or other insulating material with binding posts for making connections. The line of resistors begins with one of 20 megohms and continues in steps of 20 up to 280 megohms, a

The Manufacturer's Bulletin Page

KEARNEY
Hi-Line Equipment News

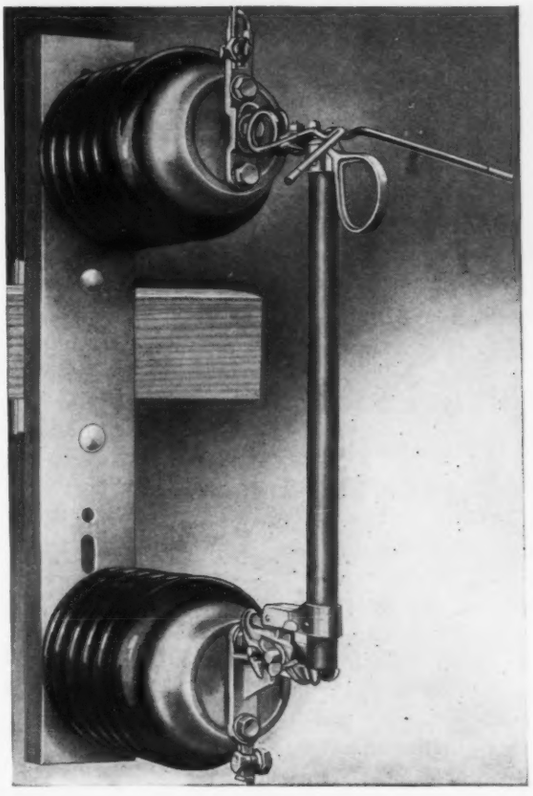
NEW PRODUCT INFORMATION

Latest News | St. Louis, Mo., | World Copy

STATION POST INSULATORS—POINT PRESSURE CONTACTS—FEATURE 100 AMP. TRIP OUTS

Pin and Cap Type Insulators, Formerly Standard, Now Optional Since Demand for Modern Insulators

Freedom from Radio Interference One of Six Important Advantages



THE adoption of Station Post Insulators as standard for the Kearney line of 100 ampere Trip Out Fuse Switches has been heartily approved by operating men everywhere who have had occasion to study the advantages of these insulators in comparison with the pin and cap type, formerly used, which are still obtainable but on optional order.

Among the outstanding characteristics which these insulators possess are: freedom from puncture; ability to withstand arc-overs; ability to handle dirt conditions; freedom from cracking; exceptional rigidity; high resistance to impact; neat appearance and freedom from radio interference at their rated normal voltage with a substantial margin of safety.

Other Features Retained

Point pressure contact, a feature which since its inception has been found highly practical; Kearnite fuse tubes; hinge contacts of proved design for positive operation, and other superior features are all incorporated in this line of 100 ampere fuse switches which are available in the following voltages: 7500/12500Y, 15,000, 23,000, 33,000S and 34,500, and cataloged respectively, 6444, 6445, 5759, 6443 and 5764.

Insulator fittings of these switches are attached to 3-inch bolt circle cap in such a manner that the insulators may be conveniently removed or replaced, provided they are standard N. E. M. A. insulators with 3-inch bolt circle.

Channel bases are made of heavy galvanized steel channel iron to conform to A. S. T. M. specifications. Mounting holes will be provided to conform to special template when furnished.

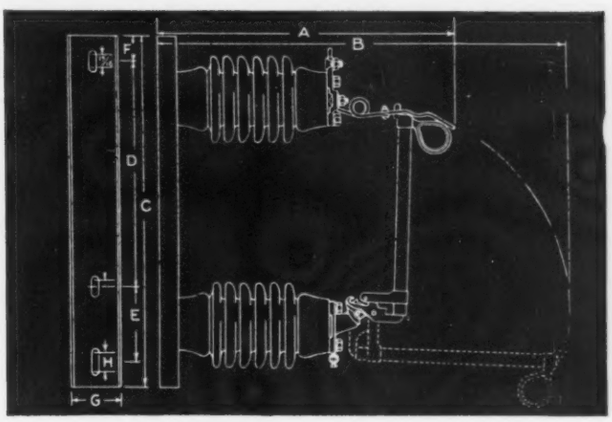
Further information and prices of these Trip Outs may be had by addressing the James R. Kearney Corporation, St. Louis, Mo.

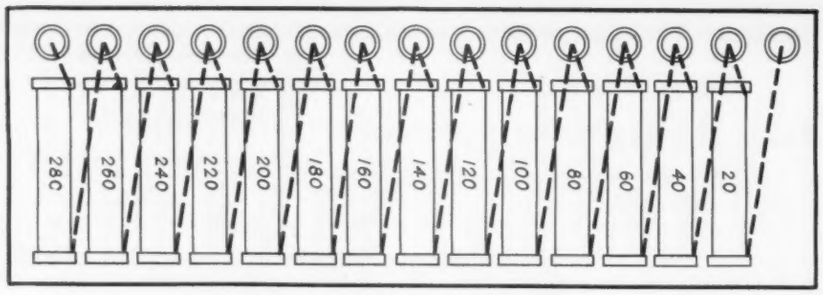
JAMES R. KEARNEY CORPORATION
4224-42 Clayton Ave., St. Louis, Mo.—*Canadian Plant*, Toronto

100 AMP. TRIP OUT FUSE SWITCH

Cat. No.	RATING		DIMENSIONS—Inches							
	Volts	Amps.	A	B	C	D	E	F	G	H
6444	7500/12500 Y	100	18¼	22½	28	18	6	2	4	1½
6445	15,000	100	20¾	28	28	18	6	2	4	1½
5759	23,000	100	24¾	33¾	28	18	6	2	4	1½
6443	33,000 S	100	28¾	40¾	36	24	6½	2¾	5	15/16
5764	34,500	100	30¾	40¾	36	24	6½	2¾	5	15/16

USE KEARNEY QUICK-ACTION FITALL FUSE LINKS





Megger tested with radio resistors

total of fourteen. If the megger reads this range of resistance values with fair acuracy, then there is not very much that can be wrong with it. Of course the tolerance in ordinary low-priced radio resistors is quite broad and a check made with them can only be approximate.

•

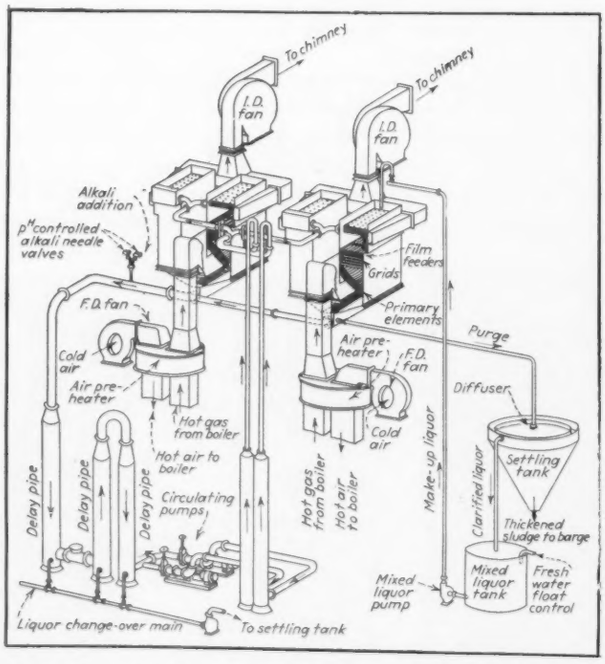
Sulphur Extraction for British Station

England's newest generating station, the 130,000-kw. Fulham plant near London, went into operation on September 26. With its ultimate planned capacity of 310,000 kw. Fulham will be the largest municipally owned station in Great Britain. At present it houses two 60,000-kw. units and a 10,000-kw. auxiliary unit with a third 60,000-kw. unit under construction. Two additional units are planned.

One of the contingent conditions attached to the Electricity Commissioners' consent to the erection of the station near London was that apparatus be provided to prevent discharge of soot or sulphur compounds into the air. In the sulphur extraction plant installed to meet this condition gases are scrubbed with lime or chalk liquor. The scrubber consists of woolen grids, over which the washing liquor falls by gravity from a head tank. Liquor is not discharged, but is recirculated at 13,000 gal. per hour per boiler. Fresh lime is added as the $Ca\ So_3$ or $Ca\ So_4$ (by combination with SO_2) is drawn off to settling tanks, in which solids are removed and clear liquor is returned to the system. A large excess of solid calcium sulphate is suspended in the liquor, as deposits form on crystals in preference to the scrubbing surfaces.

Each boiler equipment consists of two units and can deal with 105,000 cu.ft. of gas per minute at extraction efficiencies of 98 per cent for grit and sulphur, the latter when coal has a maximum sulphur content of 1.7 per cent. Entering and leaving temperatures of the gas are 240 and 124 deg. F., at which they are discharged into two reinforced chimneys 300 ft. above ground.

Essential data on the ratings of equipment in the Fulham station as taken from the *Electrical Review* (London) follow: Steam pressure, 625 lb. per sq.in.; temperature, 850 deg. F.; boilers now installed, 6; steaming capacity, 260,000 lb. per hour each; boiler surface (includes superheater and economizer), 49,980 sq.ft. each; furnace volume, 13,500 cu.ft.; stoker-fired, forced-draft fans, two each of 42,000 c.f.m. capacity; induced-draft fans, two each of 105,000 c.f.m. capacity; generators, three, of which two are 60,000 kw. and one 10,000 kw.; condenser surface, 54,000 sq.ft.; heat release of furnace, 25,000 B.t.u. per cu.ft.; hourly coal consumption, 31,050 lb.



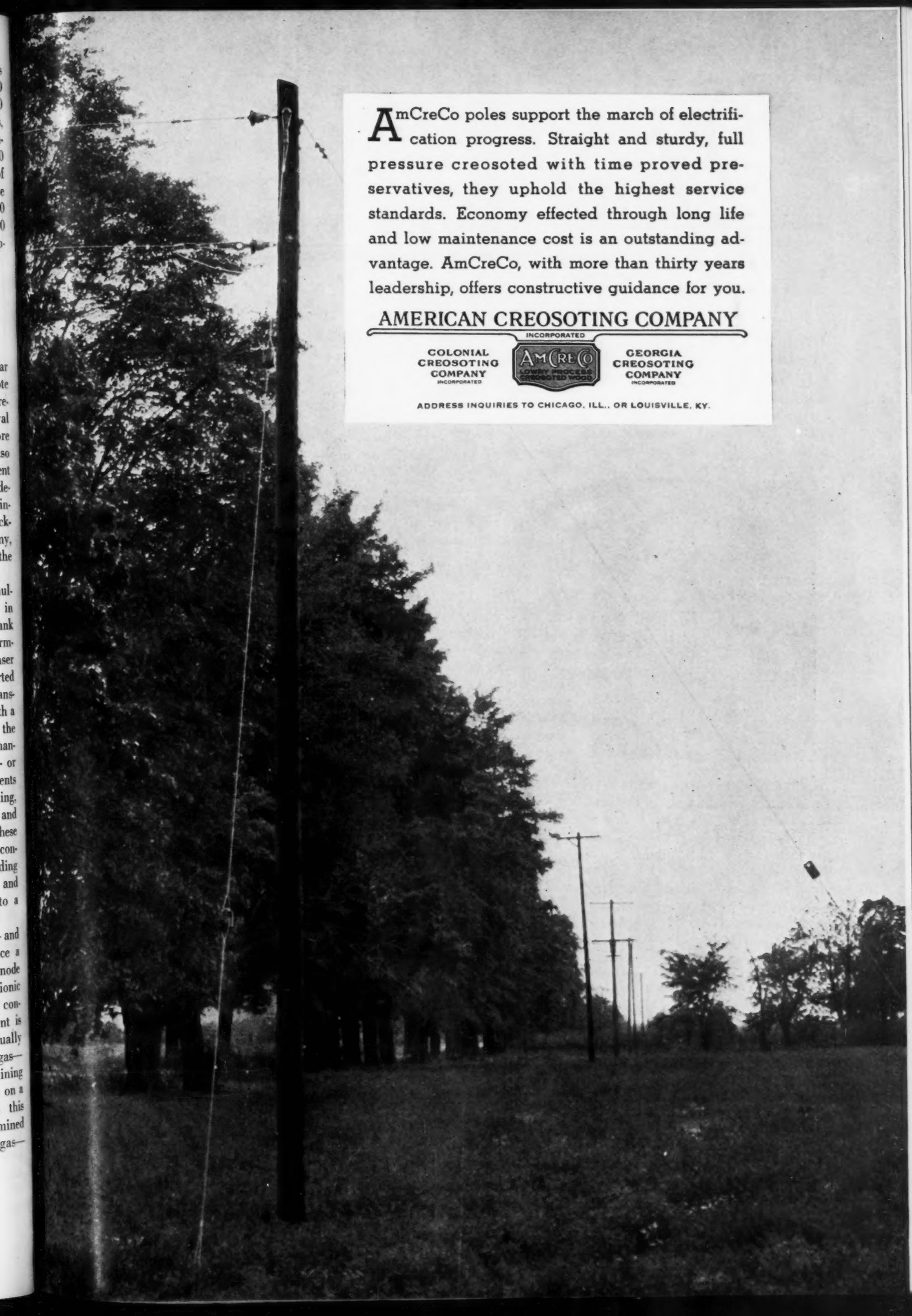
Sulphur extraction plant for new British 130,000-kw. station as shown in *The Engineer*

New Relay Indicates Transformer Faults

Faults in transformers or similar apparatus are indicated at a remote point by a new type of protective relay, permitting inspection or removal from service of the equipment before the fault becomes serious. It can also be arranged to isolate the equipment automatically, should the fault develop so quickly as to prevent this inspection. A development of the Hackbridge Electric Construction Company, Ltd., its operation is described in the *Electrical Review* (London).

A condenser unit, essentially a multiple-plate condenser, is connected in the pipe between the transformer tank and the conservator. (In transformers having no conservator, condenser chamber is replaced by an inverted box, fitted at the top of the transformer inside the tank, together with a baffle to guide evolved gas into the condenser.) Faults—such as mechanical or electrical breakdown, short- or open-circuited windings, eddy currents in the core—produce local heating, causing decomposition of the oil and the generation of gas bubbles. These gas bubbles accumulate in the condenser chamber at a rate depending on the seriousness of the fault and change the dielectric from oil to a mixture of gas and oil.

Changes in the dielectric — and hence in the capacity — produce a corresponding change in the anode current of a single-tube thermionic unit with which the condenser is connected. This variation in current is indicated by a milliammeter—usually scaled in cubic centimeters of gas—housed in the compact case containing the thermionic tube and mounted on a remote control panel. Should this variation exceed a predetermined amount—usually 500 cu. cm. of gas—an alarm circuit is operated.



AmCreCo poles support the march of electrification progress. Straight and sturdy, full pressure creosoted with time proved preservatives, they uphold the highest service standards. Economy effected through long life and low maintenance cost is an outstanding advantage. AmCreCo, with more than thirty years leadership, offers constructive guidance for you.

AMERICAN CREOSOTING COMPANY

INCORPORATED

COLONIAL CREOSOTING COMPANY INCORPORATED

AMCRECO LOWRY PROCESS CREOSOTED WOOD

GEORGIA CREOSOTING COMPANY INCORPORATED

ADDRESS INQUIRIES TO CHICAGO, ILL., OR LOUISVILLE, KY.

News ABOUT PEOPLE

Dr. F. G. Cottrell Wins Washington Award for 1937

Dr. Frederick G. Cottrell of Washington, D. C., who perfected the process by which the cost of helium gas was reduced from $1,700 to 10 cents a cubic-foot, has been chosen to receive the Washington Award for 1937. Dr. Cottrell is president of Research Associates, Inc.

He is widely known as a chemist and metallurgist, a former director of the U. S. Bureau of Mines and director of the Fixed Nitrogen Laboratory, U. S. Department of Agriculture. Besides his achievements in the cheap production of helium, Dr. Cottrell is famous for his work in nitrogen fixation, for his processes of cleansing gases of dust and dirt by electrical precipitation and for research in petroleum technology. The award has been made for his "social vision in dedicating to the perpetuation of research the rewards of his achievements in science and engineering."

The Washington Award is administered by the Western Society of Engineers in co-operation with the A.I.E.E., A.S.M.E., A.S.C.E. and the A.I.M.&M.E. The tangible symbol of the award is a bronze plaque mounted in marble. This will be formally presented to Dr. Cottrell at a dinner on February 23. The place of presentation will be announced shortly.

•

▶ BEN E. NILES has been elected president of the Henderson County (Ky.) Rural Electrification Association. Mr. Niles is also president of the Kentucky Farm Bureau Federation and the Henderson County Farm Bureau.

•

Wisconsin Gas & Electric Announces New Appointments

Donald G. Evans, assistant general manager of the Wisconsin Gas & Electric Company, has been named general manager. Ralph E. Moody, formerly general manager, remains in actual charge of all company operations as vice-president. Mr. Evans is a graduate of the University of Illinois and has been connected with the Wisconsin utility since 1919.

Donald G. Evans

Stanley B. Sherman has been appointed chief engineer in charge of both the electrical and gas engineering departments. He is a graduate of the Armour Institute of Technology and has also been connected with Wisconsin Gas & Electric since 1919.

Stanley B. Sherman

•

J. R. Read Vice-President of Canadian Westinghouse

Canadian Westinghouse Company, Ltd., announces the election of John R. Read, district manager at Vancouver, as vice-president of the company, with headquarters at Hamilton. Mr. Read, while a Virginian by birth, is a naturalized Canadian citizen and was associated with the Westinghouse Electric & Manufacturing Company early in his career. While at East Pittsburgh Mr. Read obtained practical experience in the various departments connected with the complete line of Westinghouse equipment.

In 1901 Mr. Read was engaged as consulting electrician for various gold dredging companies in California and later as electrical engineer for the Northern California Power Company at Redding, Cal. His Canadian experience commenced in 1904 with his engagement as district office sales engineer for the Vancouver district office of the

YUH KNO', FRED,
. . . I PULLED IN THIS
CABLE OVER 20 YEARS
AGO AND BY GOLLY...
IT STILL LOOKS GOOD
AS NEW.....YOU
GOTTA ADMIT...THIS
ORANGEBURG CONDUIT
IS BEST FOR CABLE..
...AND.....
STATE LINE
MAINTENANCE
ENDS
ORANGEBURG
THE FIBRE CONDUIT CO
ORANGEBURG N.Y.
SALES AGENTS
GRAYBAR ELECTRIC CO.
GENERAL ELECTRIC SUPPLY CORP.
YOU SAID IT!

Canadian Westinghouse Company. In 1908 he was appointed district manager. Mr. Read's participation in many of the important B.C. hydro-electric projects, together with his direction of the merchandising activities of the company in British Columbia, equip him with a broad and creative appreciation of the future of the electrical industry. He is a past-president of the Vancouver Electric Club and director and past-chairman of Vancouver section of the American Institute of Electrical Engineers.

•

▶ FRANK D. COMERFORD, president of the Boston Edison Company and chairman of the New England Power Association board, has been elected a member of the corporation of the Massachusetts Institute of Technology.

▶ N. G. WALLACE, attorney of Bend, Ore., has been appointed by Gov. Charles H. Martin of that state as Public Utilities Commissioner to succeed Frank M. McCulloch, resigned. The appointment and resignation were effective January 1.

▶ WILLIAM T. POULTERER has been appointed sales manager of the General Control Company, Cambridge, Mass., where he will be responsible for all sales and advertising activities. He is well known in the utility and industrial fields and previously has held executive positions with the Philadelphia Electric Company, Electrical Development & Machine Company, American Brown Boveri Corporation and the RCA Manufacturing Company.

▶ MAJOR ARTHUR R. WELLWOOD, formerly regional director of the Federal Power Commission's newly established office at Atlanta, Ga., has been appointed supervising engineer and placed in charge of all P.W.A. power projects in Nebraska. PERCY H. THOMAS, who has been associated with the commission for the past three years, has been appointed to succeed Mr. Wellwood in Atlanta.

▶ P. W. THOMPSON, Detroit Edison Company, has been appointed by the electric light and power group of the American Standards Association as its representative on the Standards Council, the general committee of the American Standards Association in charge of approval of all standards by the A.S.A. Mr. Thompson is succeeding I. E. Moultrop, Boston Edison. W. C. Wagner, Philadelphia Electric Company, and R. H. Tapscott, Consolidated Edison, N. Y., continue as the two other representatives.

•

T. D. Montgomery to Manage Cutler-Hammer Foreign Sales

T. D. Montgomery has been appointed manager of the foreign sales division of Cutler-Hammer, Inc. Mr. Montgomery has had wide experience in the application of Cutler-Hammer products, general company policies and methods of distribution. He brings to the foreign sales division a

deep appreciation of the need for closer contact and service to the many Cutler-Hammer customers in foreign countries.

•

▶ FRED T. WHITING, northwest district manager Westinghouse Electric & Manufacturing Company, was unanimously elected president of the Electric Association of Chicago at a recent meeting of the board of directors. Mr. Whiting has served the association as a director and as treasurer for many years.

▶ EDWARD J. SPLAN has been appointed superintendent of the municipal electric light plant at Norwalk, Conn., to succeed the late William H. Dieringer.

▶ CURTIS E. PLASS, research engineer in the high-voltage insulation laboratory of the Anaconda Wire & Cable Company, Hastings-on-Hudson, N. Y., for the past 4½ years, is now located with the American Steel & Wire Company at Worcester, Mass., where he is engaged in research work on lead sheathing.

OBITUARY

▶ WILLIAM D. GHERKY, a consulting engineer, inventor and manufacturer, died, of acute coronary thrombosis, January 17 in Philadelphia, Pa. He was in his seventieth year. A former research associate of Thomas A. Edison, Mr. Gherky supervised the installation of the underground electrical distribution in New York for the Edison Electric Company in 1891. Going to Philadelphia in 1900, he supervised the electrification of that city's surface lines and organized the Railway Track Work Company, of which he was president until his death. Mr. Gherky was a fellow of the American Institute of Electrical Engineers and a member of the American Association for the Advancement of Science.

▶ HERMAN ANDRAE, one of the pioneers in the electrical contracting field in Wisconsin, died January 12 at his home in Milwaukee, in his seventy-seventh year. He was the son of Julius Andrae, president of Julius Andrae & Sons Company, some years ago one of the largest electrical supply houses in the state. In 1905 Herman bought out the contracting department of Julius Andrae & Sons and incorporated under the name of the Herman Andrae Electrical Company.

▶ EUGENIO NICOLINI, well-known Italian electrical engineer, who for many years was resident in France, where he was the director of the undertakings of the Société d'Electricité de Paris and the Société d'Electricité de la Seine, died recently at the age of 64 at Gardone, Italy. He was an authority on the design and construction of steam-operated generating stations and took an active part in the design and construction of the big plants at Ivry and St. Denis on the outskirts of Paris.

▶ RAMESES A. HAMMACK, distribution engineer of the Public Service Company of Colorado, died in Denver, of a heart attack, December 30 at the age of 64. He was an authority on wood pole construction. He had been employed in various engineering capacities by a number of utilities after going to Colorado in 1896, becoming affiliated with the Public Service Company in 1922 when the Denver Gas & Electric Company was merged with that organization.

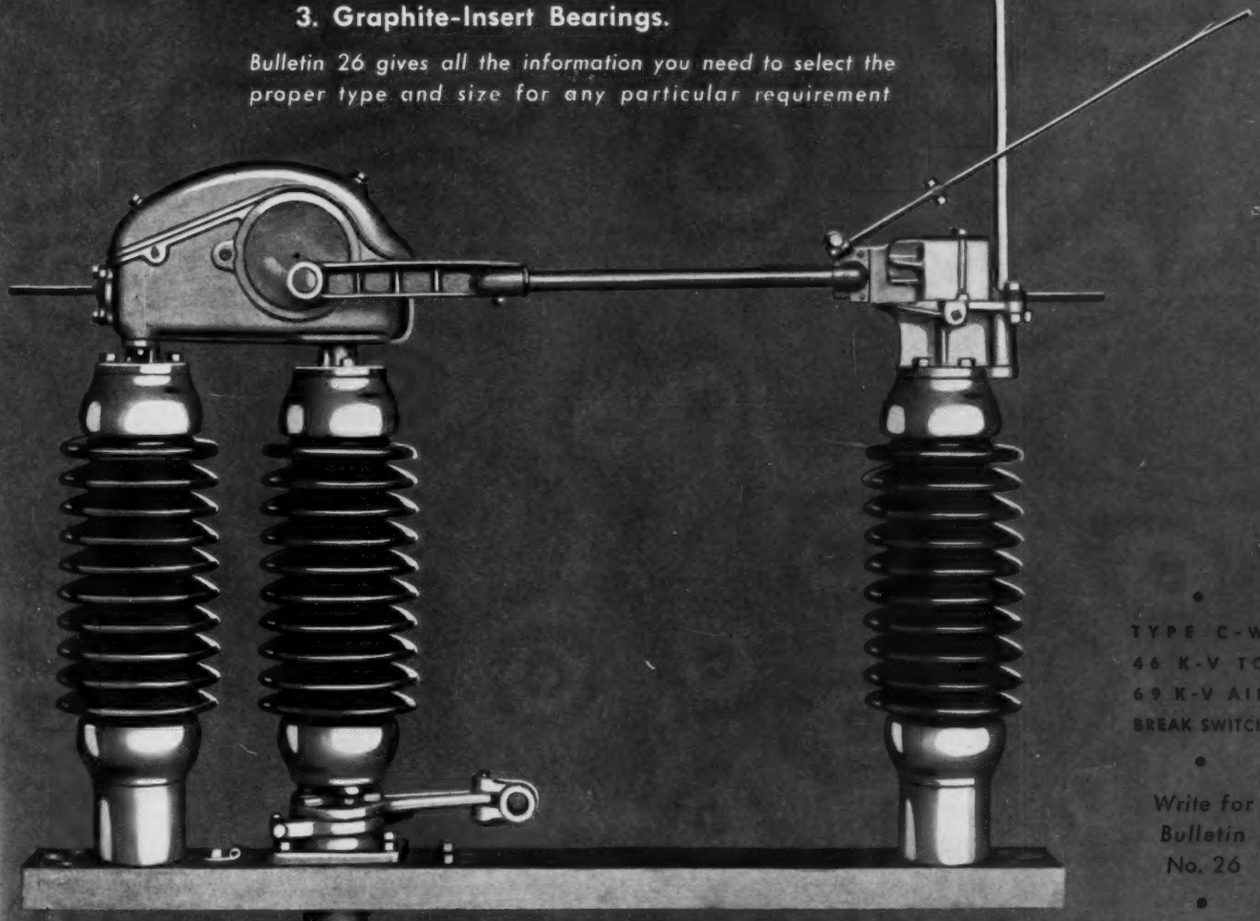
"IT'S ALWAYS FAIR WEATHER"

. . . so far as HI-VOLTAGE is concerned

• Other air-break switches give dependable service under most conditions but only HI-VOLTAGE can go the whole distance. • • • Dependable service under *any* weather conditions—for a practically unlimited period of time—is *assured* by:

1. **Totally enclosed, all-bronze, accurately machined, operating mechanism.**
2. **Monel Ball Bearings.**
3. **Graphite-Insert Bearings.**

Bulletin 26 gives all the information you need to select the proper type and size for any particular requirement



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TYPE C-W
46 K-V TO
69 K-V AIR
BREAK SWITCH

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Write for Bulletin No. 26

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HI-VOLTAGE EQUIPMENT CO.

2891 EAST 79TH STREET • CLEVELAND, OHIO

Manufacturing AND MARKETS

Electrical Shipments Aid Railroad Traffic

The electrical industry as a whole is by far the best customer the transportation industry has, in the opinion of H. L. Andrews, vice-president of General Electric Company. Speaking before the recent dinner of the Philadelphia Traffic Club, Mr. Andrews stated that the electrical industry not only gave transportation agencies a large volume of freight in the raw materials which go into the finished products whch leave the various factories, but that it also created a continuing, growing business for the railroads. "Every electrical product sold increases the use of electricity; electricity uses coal, and the shipping of coal means profitable traffic for railroad companies," he declared.

It was pointed out by Mr. Andrews that during 1935 shipments of incandescent globes produced nearly 8,000,000 ton-miles of railroad traffic. The increased use of lamps caused electric utilities to use nearly 20,000,000 tons of coal to generate the additional energy, which gave the railroads 4,000,000,000 ton-miles of coal transportation. The use of electrical appliances and repeat business give the railroads additional business in the transportation of coal to be used to generate electricity.

•

Aircraft Maker to Spend $600,000 for Machinery

Glenn L. Martin Company, Baltimore, will spend about $600,000 on new machinery for its airplane plant, which is electrically operated throughout. The new equipment will be a part of a $2,000,000 plant expansion which will give the establishment the largest assembly floor in the world for the manufacture of aircraft and which will double the capacity of the plant. The additions will include a 300 x 500-ft. assembly hall with headroom clearance of 40 ft. It is said that this will be the largest unobstructed airplane factory space in the world.

•

Fairbanks, Morse Closes Contract With Rural Group

The Beloit, Wis., works of Fairbanks, Morse & Company will supply up to 600,000 kw. of electricity a month at 1½ cents per kilowatt hour to more than 1,200 members of the Rock County Rural Electric Association. The contract between the cooperatives and Fairbanks, Morse was closed last week for a three-year period. Under its terms the company will make no minimum charge the first year.

•

Continental-Diamond Fibre to Intensify Sales Efforts

Business has shown a satisfactory increase and "we look for a further increase during the coming year," according to J. P. Wright, president of Continental-Diamond Fibre Company.

Mr. Wright stated that the company plans to intensify its sales efforts during the year and to enlarge manufacturing facilities. He also declared that the new products introduced have been well received and the company plans further development during the year.

•

Air-Conditioning Sales Up

Installed cost of equipment manufactured by member companies of the Air Conditioning Manufacturers' Association will reach at least $85,000,000 this year, an increase of 60 per cent over the $52,500,000 record total of last year, according to William B. Henderson, executive vice-president.

Kelvinator Shipments Show Sharp Increase

Shipments of Kelvinator refrigeration products for the first three months of the fiscal year beginning October 1 showed an increase of 29.8 per cent, according to H. W. Burritt, vice-president in charge of sales.

Unit shipments of Kelvinator refrigeration products for the first three months totaled 53,607, as against 41,270 units in the same period of the preceding fiscal year.

Shipments of Kelvinator commercial refrigeration units for December showed an increase of 47.5 per cent over the same period the year before, according to J. A. Harlan, manager of commercial sales.

Campbell Wood has been appointed to head the new nation-wide division to assist public utilities in the expanson of the use of electrical service. Robert Elliott Barnes has been appointed assistant.

•

Welding Course in New York

A special course in arc welding design and practice is being sponsored by the Lincoln Electric Company, Cleveland, Ohio. The course will begin on February 1 and last through February 5. Meetings will be held in the Port of New York Authority Building, Fifteenth Street and Eighth Avenue, New York. The course will be under the direction of E. W. P. Smith, nationally known welding authority of Cleveland, Ohio, and R. E. Kinkead, welding consultant.

•

Opens New Sales Office

Ajax Flexible Coupling Company of Westfield, N. Y., has opened a new sales office in Louisville, Ky. This is the company's twenty-first sales office

insuring dependable connections in L-M DISTRIBUTION TRANSFORMERS

In assembling L-M Transformers special care is taken to insure electrical and mechanical connections that "stay put" . . . that eliminate radio interference . . . and yet are easy to change. "Palnuts" are used. Here is just one example of the many "little things well done" to make L-M Transformers easy to adjust and thoroughly satisfactory in performance. Write to South Milwaukee, Wisconsin, for L-M Transformer Bulletin, LMB 6364.

LINE MATERIAL CO.

in the country. The Ajax line of flexible couplings and reciprocating screen drives is being handled by Alfred Halliday, in the Starks Building.

•

Westinghouse to Display Equipment at Textile Exhibit

At the twelfth Southern Textile Exposition at Greenville, S. C., April 5 to 10, Westinghouse Electric & Manufacturing Company will display the latest developments in electrical equipment for use in textile mills. The exhibit will include loom motors and loom motor control, spinning frame motors and spinning frame motor control, newest instruments and measuring devices, switchboards, automatic circuit breakers and the "crossfield" type "Flexarc" welder with precision arc control.

•

Memphis Electric League To Give Building Advice

Intending to set up standards of adequacy, comfort and convenience in the average residence, the Memphis Electric League has started functioning with the co-operation of electric contractors and dealers who are members of the organization. The league will offer a free service to the public, rendering aid to those planning new homes or in modernizing present ones.

The public will be invited to consult the league without cost or obligation and will have the opportunity of taking advantage of the services of an electrical engineer who will make suggestions not already covered by plans of the builder, Joseph A. Fowler, president, declared.

•

Orders Turbo-Alternator

A repeat order for a 30,000-kw. steam turbo-alternator for the Ford automobile works at Dagenham, England, has lately been placed with the British Thomson-Houston Company, Ltd. The set is designed to work with steam at 1,200 lb. per square inch.

New York Metal Prices

	Jan. 20, 1937 Cents per Pound	Jan. 26, 1937 Cents per Pound
Copper electrolytic	13.00*	13.00*
Lead Am. S. & R. price	6.00	6.00
Antimony	14.25	14.25
Nickel ingot	35.00	35.00
Zinc spot	6.35	6.35
Tin Straits	51.00	50.00
Aluminum, 99 per cent	19—20	19—21

* Delivered Connecticut Valley.

Field Reports on Business

Reports from the field indicate that while the flood has temporarily delayed shipments, no cancellations of large orders placed in recent weeks have been received. Brisk demand continues for heavy electrical equipment and lighting equipment is being maintained at a high level.

NEW ENGLAND

Sales of electrical equipment in the New England area are forging ahead and show a slight increase over the volume reported for the first month of last year. Heavy electrical equipment orders announced this week include a 5,000-kw. steam turbo-generator placed a short time ago and several large motors rated above 50 hp. Specifications are being prepared for a 25,000-kw. high-pressure steam turbo-generating unit for superposition at the L Street station of the Boston Edison Company and for additional boiler capacity. The demand for group drives of looms and other equipment with related larger motors, control and wiring is rapidly increasing, one textile machinery maker having received orders for 1,100 looms thus equipped within a fortnight. The Power Transmission Council's work in this field is challenging interest.

Small motor sales are active; one manufacturer reports a steady demand and a wide variation in applications. Machine manufacturers continue to draw heavily on small motor stocks in this district. Small switches and control apparatus sales are encouraging.

Arc-welding outfits are in demand, with 150-amp. sizes selling well. One manufacturer reports an increase in the number of inquiries for welders compared with last year. Electric furnace makers are busy; sales for the first three weeks of this year recorded by one well-known manufacturer of heat-treating furnaces up to 40 kw. are ahead of last year.

Inquiries for street-lighting supplies are more active. One oil-burning equipment distributor has prepared for doubling sales in this district during the coming year in view of the active demand for new electric homes. All-electric kitchen units loom favorably in interest and sales of these reported last week include one assembly costing $2,300. Merchandising is maintaining a steady trend.

PACIFIC COAST

Bids and awards continue at a high level, though immediate business has dropped in various retail districts due to the strike and also because of illness of contractors' and wholesalers' personnel. Recent bids and requests for contract prices include $125,000 cable for interurban system on San Francisco Bay Bridge and a $150,000 lamp contract for the Southern Pacific System from Portland to Los Angeles along the coast. Proposed official constructions include a million-dollar state fair structure at Sacramento and new post offices for Provo, Portland, San Diego, Santa Maria, Santa Barbara, Watsonville, and Ontario.

Bridges are responsible for much construction in the Bay area, including elaborate electrical toll plaza installations for Golden Gate Bridge, several street-lighting jobs averaging $7,500 each for approaches and about $2,000,000 of reconstruction for firms now on site of proposed interurban terminal. Exposition awards almost in construction stage cover $1,181,544 for twelve exhibit places and $275,000 for special ferry terminal. Electrical machinery orders include $5,000 worth of motors, size 15 to 125 hp.; several distribution transformers and a 375-kva. regulator, value $7,500. Pumping equipment predominates and a record-breaking year is seen for the sale of this material because of the low level of snow storage. Mines continue to be the cause of many line extensions, averaging 2 miles for 300 hp., with three-year dredge operation. Considerable electric motor replacement of Diesel engines is reported in these isolated districts.

CHICAGO

Industrial activity in this area held up well last week, running close to the highest levels in seven years. Employment and payrolls were slightly above the preceding week. Retail sales receded somewhat, but are expected to pick up sharply within the next month.

Activity in the electrical industry continues at a steady pace. Reports from contractors are especially encouraging. Orders for industrial equipment are substantially ahead of last year. Bids were asked last week on 1,500 residential fixtures. Edison General Electric Appliance Company received an order for 7,802 ranges. The city ordered two large ventilating fans. Contract was awarded for traffic signals on Michigan Avenue for $32,956. Electrical work in two P.W.A. school jobs awarded last week will amount to $32,245. Another P.W.A. contract will include $54,844 for electrical work in a hospital.

The building industry in and around Chicago is especially optimistic as additional projects were announced for spring construction. Several industrial buildings scheduled for early completion will result in beneficial electrical contracts.

NEW YORK

Strike of B-M.T. power plant employees and the attempt to hold the plant as "hostage" by a sit-down is everything but assuring to business in its relation to workers. The traction company is enlarging its power plant to meet demands for electricity. Observers see possible future labor troubles as strikers use the sit-down weapon to force settlement of, or alleged, grievances. Reports on sales of electrical appliances indicate that business in this line will continue good. Many concerns are planning modernization programs looking toward purchase of heavy electrical equipment.

Preparations for the New York World Fair in 1939 is anticipated to result in a stimulus of trade in the near future as construction proceeds . The Dewey investigation of the racketeering in the electrical contracting trades is expected to be beneficial. The sharp decline in automobile activity is making itself felt in some lines of business, which is reflected in the electrical trades. There is optimism in the steel industry with production at a seven-year high. Some of this optimism is spreading to other industries which are looking to better business in the spring.

Impacting Implosions!

Revere Condenser Tubes

THE IMPACTS of collapsing vortices in condenser tubes—implosions that tend to detach particles of protective film from the metal—have a cumulative effect that is believed to be an important factor in condenser tube erosion and corrosion.

Other factors in erosion and corrosion are bubbles of entrained air, suspended solids, chemical impurities in the water supply, and high tube-wall temperatures.

Maximum economy and availability depend on the proper matching of tube characteristics with conditions encountered in each respective application.

Revere condenser and heat exchanger tubes are available in Cupro-Nickel 70-30, Cupro-Nickel 80-20, Revalon (Aluminum Brass), Admiralty Metal, Herculoy, 85-15 Brass, Muntz Metal, Copper, Arsenical Copper, and other materials.

It is the function of Revere Technical Advisory Service to assist you in selecting from this wide range of Revere tube materials that tube having the proper combination of characteristics to best meet your individual case requirements. If you desire, an R.T.A.S. technician will make a thorough study of your condenser and heat exchanger tube needs. Ask for new Revere Condenser Tube bulletin containing important data. Address our Executive Offices, 230 Park Avenue, New York City.

Revere Copper *and* Brass

INCORPORATED

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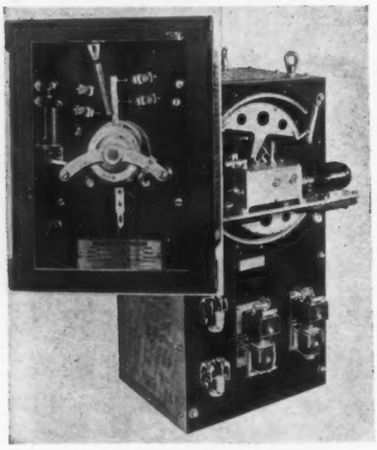
New EQUIPMENT AVAILABLE

Voltage Regulators

New voltage regulators of high capacity have been designed especially for the control of large synchronous motors where high speed of voltage recovery, accurate voltage control and reliability are essential. In



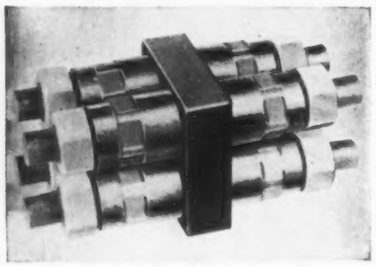
Type J, one of new line. **Allis-Chalmers Mfg. Co.,** Milwaukee, Wis.

modified form they can be obtained to control large d.c. generators. Two main parts of complete equipment are the voltage control element (inset) and rocking contact motor-operated rheostat with high-speed contactors and relays. Control element is connected to machine to be regulated through suitable potential transformers and operates its contacts when voltage differs from normal value.

•

Cable Connector

Designed for interconnecting single-conductor secondary insulated underground cables, with or without lead sheath, this device is said to eliminate the use of solder and tape and to require only a wrench for installation. Copper bus is covered with a molded oil- and moisture-resistant rubber compound. Connectors and cable ends are covered with a molded bakelite insulator sealed at the ends by means of a bushing compressed on the cable with a gland nut.

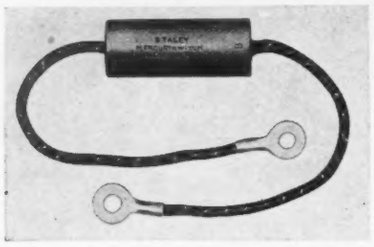


Multitap, eight-way type shown; interchangeable cable heads for conductor sizes up to 500,000 circ.mil. **G & W Electric Specialty Co., Inc.,** Chicago, Ill.

•

Mercury Switches

Recently announced mercury switches consist of a mercury make-and-break contact housed in a hydrogen-filled metallic envelope and are designed to be installed in special clips similar to cartridge clips. The switch operates by tilting it through an angle of approximately 10 deg. with the horizontal; reversal of circuit function is said to be obtained by simply reversing the



Staley metallic mercury switches; in 5, 10 and 15 amp. capacities and various types. **Electric Switch Corp.,** Columbus, Ind.

switch in its clips. Suggested applications for the switches include their use in closing magnetic brake circuits, as safety switches which prevent the operator from coming into contact with the work until the machine is stopped through an auxiliary circuit, and indirect application to levers which start and stop machines in shops.

•

Street Lighting Unit

Reflectolux, Jr.; designed for maximum size lamp of 500 watts; high-voltage porcelain hood available for circuits over 5,000 volts. **Westinghouse Electric & Mfg. Co.,** East Pittsburgh, Pa.

Recently announced street lighting luminaires are said to distribute light evenly along the street by means of their carefully designed reflectors and bi-flectors of Alzak-processed aluminum. Unit consists of a canopy, reflector, globe-holding ring and globe. Light center of the lamp is 1¾ in. above the bottom of main reflector. Facilities for mounting a series socket and receptacle, mogul multiple or medium multiple sockets are provided inside the canopy.

•

Synchronous Timer

This synchronous interval timer has been designed for "built-in" installations and has the dial mounted on the outside of the case. It is started by turning the dial in the

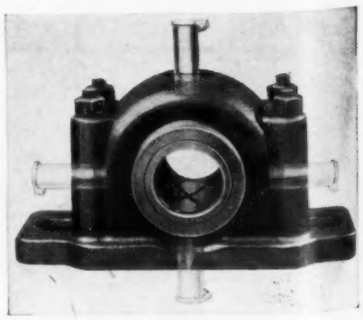
Type M-1; in 5 or 15-amp. models; standard time units are 50 seconds, 5, 20 and 50 minutes. **Zenith Electric Co.,** Chicago, Ill.

direction of the arrow until it trips the snap switch "on." Dial then revolves and the indicating pointer trips the switch "off." Trip pointer on the dial is said to be easily adjusted for pre-set-time and may be locked in position, so that further adjustment is not necessary if time is to be repeated. Single-pole, single-throw or double-pole, double-throw models are available.

•

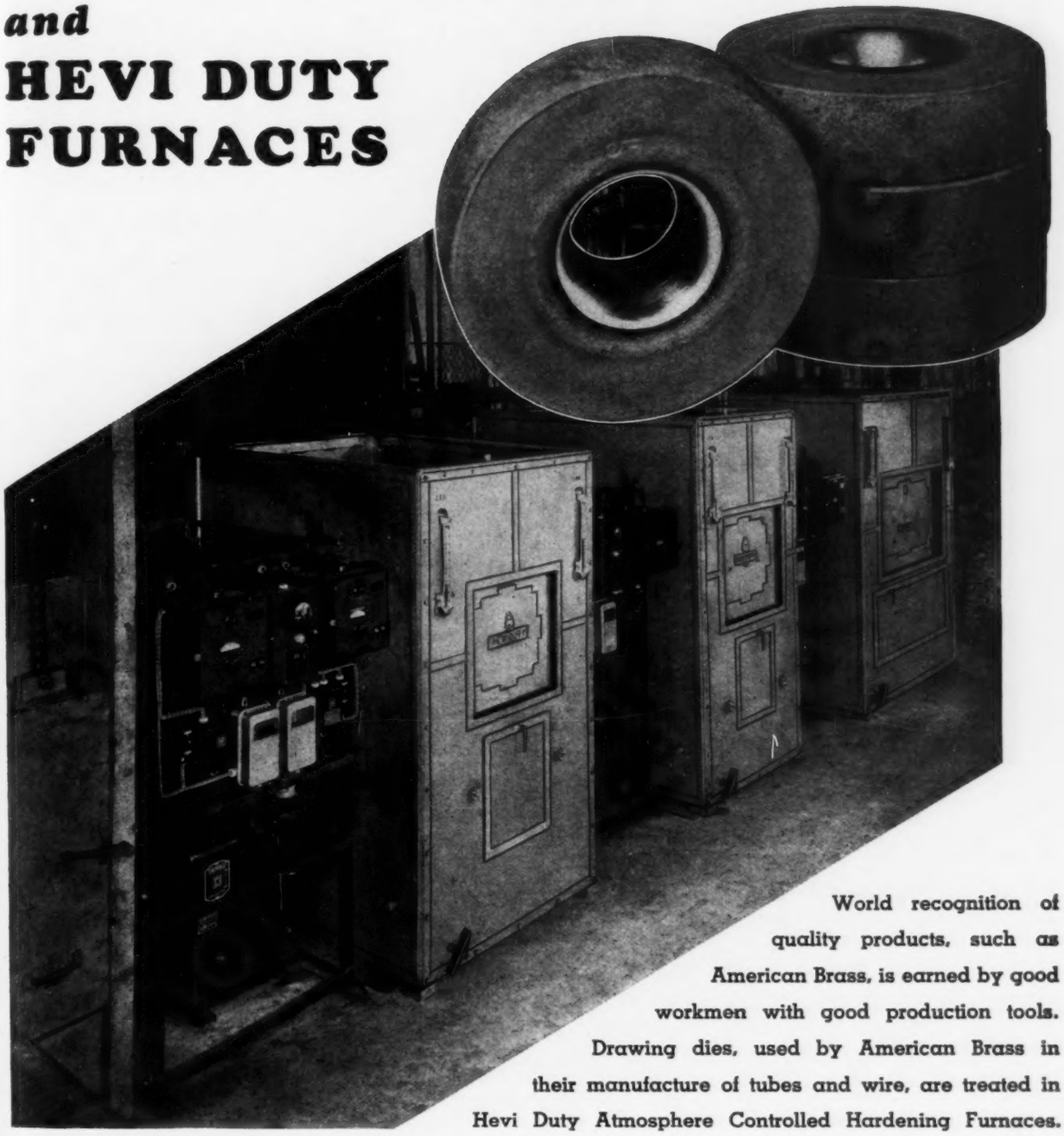
Pillow Block

A new pillow block can be mounted in any position according to the requirements of the machine, it is claimed, it being necessary only to select the mounting position



Universal double reservoir oil return pillow block. **Randall Graphite Products Corp.,** Chicago, Ill.

AMERICAN BRASS
and
HEVI DUTY FURNACES



World recognition of quality products, such as American Brass, is earned by good workmen with good production tools. Drawing dies, used by American Brass in their manufacture of tubes and wire, are treated in Hevi Duty Atmosphere Controlled Hardening Furnaces.

The furnace shown in the center of the illustration is equipped with Alloy 10 Heating Elements.

HEVI DUTY ELECTRIC COMPANY

HEAT TREATING FURNACES HEVI DUTY ELECTRIC EXCLUSIVELY

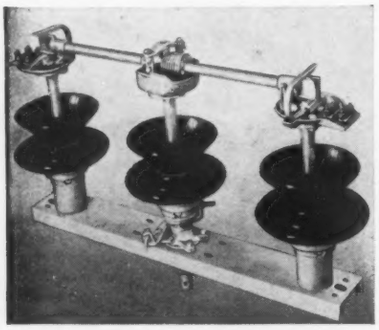
MILWAUKEE, WISCONSIN

needed, unscrew the oil cup, turn the block to the chosen position and reinsert the oil cup vertically. Oil placed in the upper reservoir feeds the shaft through graphite feed plugs and pressure-packed channels. Unconsumed oil is directed through recovery grooves into the lower wool-packed reservoir and then fed back to the shaft and bearing through lower graphite feed plugs.

•

Low-Voltage Switch

Current is carried from one self-cleaning contact of this double-break switch to the other through a solid copper tube, no flexible shunts or connections being used. In



Type "TTT"; ratings from 34.5 to 69 kv., on 3-in. bolt circle N.E.M.A. standard insulator units. **Railway & Industrial Engineering Co.**, Greensburg, Pa.

opening the switch, contact pressure is removed before the blade moves; in closing, pressure is applied after the blade comes to a stop in the closed position, the manufacturer states. It can be furnished for upright or inverted mounting and with direct or offset control mechanism.

•

Arc Welders

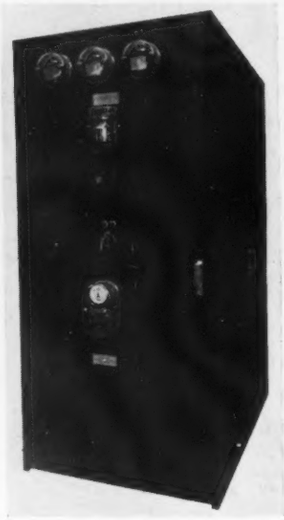
"Giant Grip Junior"; four models, from 90 to 300 amp. **Giant Grip Manufacturing Co.**, Oshkosh, Wis.

Four a.c. welders have been announced, supplementing the manufacturer's line of standard welders. Said to have the same safety factor, insulation thickness, temperature rise and ease of operation of the standard welders, these models are specially designed transformer types—not auto-transformer types—but without reactance control, static high-frequency arc or sheet metal attachment. Contrasting with the 27 and 36 controls of the standard welders, two of these models have ten controls, the other two, 16.

•

Switchgear

Steel-inclosed switchgear of this type finds application in industrial pumping stations, steel mills, sewage plants and the like for controlling large induction motor sets. Unit illustrated controls a 400-hp., 2,200-volt, three-phase, squirrel-cage, across-the-line-starting motor, driving a 250-kw. d.c. generator and 20-kw. exciter, the output furnishing power for a blast furnace skip hoist. Overload, under-voltage and temperature relays, polyphase watt-hour meter and control switch are mounted on the front panel; oil circuit breaker, metering transformers and disconnecting switches are mounted inside the cubicle, behind felt-gasketed locked doors.

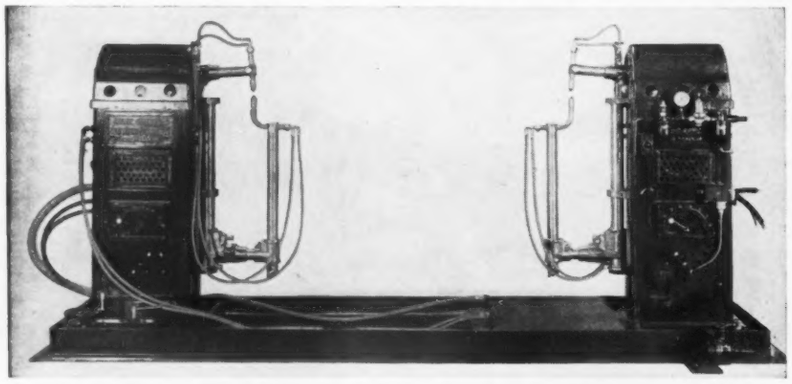


Can be furnished with oil circuit breakers ranging from 7,500 volts, 25,000 kva. to 15,000 volts, 500,000 kva. and any desired arrangement of relays and metering facilities. **Delta-Star Electric Co.**, Chicago, Ill.

•

Duplex Spot Welder

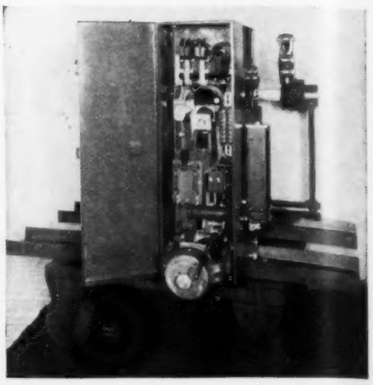
One of these automatic, air-operated and time-controlled spot welders is stationary; the other may be moved along the carriage by means of a hand wheel and locked by a screw clamp. Welder has been designed for welding refrigerator cases, filing cabinets and the like; manufacturer states that speeds up to 100 spots per minute may be obtained, depending on the pressure, length of stroke, thickness and quality of stock. A 50-kva. transformer is installed in each welder. Automatic timer is wall mounted.



Special twin welders; spread minimum, 10 in.; maximum, 58 in.; depth of drop, 27 in.; for 220, 440 or 550 volts, 50 to 60 cycles, single-phase a.c. **Acme Electric Welder Co.**, Huntington Park, Calif.

Oil Circuit Breaker Mechanism

A new and improved operating mechanism for the company's type FH oil circuit breakers has been announced. Increasing



Type MK-110; for type FH oil circuit breakers, 600 to 4,000 amp. **General Electric Co.**, Schenectady, N. Y.

the opening springs and modifying the trip-mechanism has provided faster opening time and permits rating all breakers at 8 cycles, according to the manufacturer. Other features of the mechanism include a portable, easily operated hydraulic device for manual closing, an improved cut-off switch and modification of the centrifugal mechanism to give greater ease in alignment at all motor speeds.

ENGINEERING DATA FROM MANUFACTURERS

Bulletins and catalogs now available to engineers by manufacturers and associations

"Lessons in Arc Welding"—Lincoln Electric Company, Cleveland, Ohio, announces a new and enlarged edition of this book, designed to give arc-welding operators a thorough working knowledge of the practical application and use of arc welding. Lessons are based on the course in arc welding conducted by the company in its plant for nearly twenty years.

Voltage Regulators—Operating principles of its Type FBR step type branch feeder voltage regulators are discussed in detail in Bulletin 1185 of Allis-Chalmers Manufacturing Company, Milwaukee, Wis. Sketches and circuit diagrams, photographs of installed units are included in the booklet; particular attention is paid to the tap changing mechanism and control circuits.

Power Pumps—Characteristics and applications of power pumps are discussed in Bulletin 6160 of Fairbanks, Morse & Company, 900 South Wabash Avenue, Chicago, Ill. Construction details, dimensions and ratings are furnished for this company's line of duplex power pumps.

Department of Commerce Bulletins—"Markets for Electrical and Gas Facilities in Residences" is a market research bulletin, incorporating the results of an analysis made in 64 cities. Lighting, cooking and refrigeration facilities data are included in the booklet. "Store Modernization Needs" is a similar analysis of the physical condition of retail stores throughout the country. Copies of both booklets may be secured from the Bureau of Foreign and Domestic Commerce, U. S. Department of Commerce, Washington, D. C.

NOW the important Question

INSULATION

"Continental-Diamond can supply that"—

MICABOND
DILECTO
DIAMOND
VULCANIZED FIBRE
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• That is the answer given by most design engineers when the question of insulation arises. There is good reason for the preference of experienced designers and engineers for Continental-Diamond insulating materials. We have pioneered in the development of laminated synthetic resinous products and Vulcanized Fibre. As a result we have established a group of insulating materials which provide a wide range of electrical, mechanical and thermal characteristics. Because we are able to furnish many types of insulating materials our recommendations are unbiased. It is our desire to help you determine the appropriate insulating material for your product or process.

We shall be happy to consult with you, make material recommendations, give you freely the benefit of our knowledge and experience gained in supplying thousands of insulating parts to many industries. We solicit your inquiries.

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NEWARK, DELAWARE

CONTINENTAL DIAMOND FIBRE COMPANY

Represented in Canada by
DIAMOND STATE FIBRE CO. OF CANADA LIMITED
Toronto—Montreal

Interconnection Provides Superior Protection

[*Continued from page 30*]

ever, where it is felt necessary to spread the cost of this project over several years, it would appear advisable to apply interconnection in the most exposed areas, first to 1½ and 3, then to the 5-kva. sizes, since the big majority of failures occur in these sizes.

Severity of exposure at line ends

It should be pointed out that of the nine transformer burnouts due to lightning only five had damaged windings, the rest requiring only a new bushing to be restored to service. It is also noticeable that 44 per cent of transformer failures and 39 per cent of fuse operations due to lightning occurred where the transformer was on the extreme end of the primary tap. This would indicate the desirability of a study to devise some means of increasing the protection applied to transformers at the extreme end of lines.

Since on the majority of new extensions the poles that will carry transformers are already known at the time the extension is started, it might be well to consider the use of a 12-ft. ground rod to be driven close against the side of the pole hole after the hole is dug and before the pole is set. This would not involve the driving of a rod deeper in undisturbed earth than is now the practice, but would insure getting the rod 4 or 5 ft. deeper into the earth, with a much better chance of reaching continuously moist earth and improving the over-all lightning protection.

Secondary fusing

A further study of transformer and fuse failures shows that while only nine transformers were damaged by lightning, eleven transformers were burned out from other causes. Five of these were burned out from overload, three from short circuit, two from unknown causes and one from moisture getting into the transformer. This makes a total of eight failures due to overload and short circuit, caused by conditions exterior to and on the secondary side of the transformer, or nearly the same number of failures as caused by lightning.

It would seem well to consider better methods of protecting transformers from this type of failure. On the smaller sizes of transformers, 10 kva. or lower, this might be accomplished by the use of the new General Electric secondary cutout fuse at much less expense than the same thing can be accomplished by the use of a secondary circuit breaker. Where these cutouts are used, we believe satisfactory results would be obtained by fusing them to blow in ten seconds at 200 per cent of transformer full load rating, the ampere rating of the fuse in no case to be less than that of the customer's main fuse.

Low-Cost Underground Used at Palm Springs

[*Continued from page 31*]

bricks and is grouted into place with the end flush with the inside surface of the brick. A plaster facing leaves a smooth surface. A precast, reinforced-concrete cover is designed so that it may be locked to the concrete tile. Wire holders are mounted on the inside of the tile to which the cables are tied for convenience in making taps. A fiber insulating cap is slipped over the bare ends of the secondary phase wires for protection. Service conduits are brought into the boxes by drilling holes through the concrete tile. The services are usually owned and installed by the customer.

Precast concrete blocks for manholes

Standard transformer manholes used in the residential areas are 5 ft. long, 4 ft. wide and 6 ft. deep, interior dimensions, and provide room for a maximum of 37½ kva. of transformer capacity. Walls and floor are built up with precast 3½x5¾x12-in. concrete building bricks upon a base of crushed rock. The building bricks have been found very satisfactory and far less expensive than poured concrete walls because of the saving in forms. Bricks are laid in a 1:3 mix of cement mortar. The top of the wall is a minimum of 6 in. above the normal ground level. An angle-iron frame is grouted to the top of the walls and the cover used is of angle frame and sheet metal and is so designed as to permit circulation of air between the cover and frame. A copper plate ground is placed below the crushed rock base of the vault. Duct lines are laid through the centers of blocks with the service boxes at lot corners. The transformer manholes, however, are installed in the streets, adjacent to property lines, where they will be accessible, but not in the way of traffic. There are few sidewalks and curbs in this picturesque town. The vaults and service boxes make a neat and unobtrusive appearance which to a Westerner suggests some part of an irrigation system.

The type of underground system described is the outgrowth of several years' experimentation with the various types in current use. It provides a system of adequate capacity and flexibility, yet at a cost which is within the reach of subdividers. The rapid expansion of this system within the past two years indicates its acceptance with both realtors and home owners. Although the general features of the system have been standardized, details are changed from time to time in accordance with the company's policy of better service at a lower cost.

Pumps Remove Storm Water

[*Continued from page 45*]

sequence. Outdoor equipment developed by the Detroit Edison Company for housing its meter and current transformers was used. The metering installation has the cabinets set flush in the pump house wall and at a convenient height for reading and testing.

A 3-in. galvanized iron conduit, incased in concrete, is used for carrying the underground service cable, which is a No. 2/0, three-conductor, 600-volt RCLC and a No. 2 M.H.D. bare neutral, from the Detroit Edison Company service pole to the current transformer cabinet. The service entrance switch is a 200-amp. type C safety switch, located directly behind the current transformer cabinet on the inside wall of the pump house.

The control cubicle provides for each motor a disconnect switch, fuses, starter, thermal overload relays, open phase and phase reversal relay, and current test links. The motor control circuits are 110-volt, protected by 15-amp., single-pole circuit breakers. A single-pole, momentary contact switch is provided to short out each float switch for testing purposes only. A two-pole, double-throw knife switch is provided to change the floats from one motor control circuit to the other. Automatic change-over equipment was considered for this feature, but due to the maintenance schedule it was decided that the scheme did not warrant the additional expense, since a man visits the pump house once a week.

F-6

Ford, Bacon & Davis Construction Corporation

To utilities that do their own engineering:

The best way to BUILD YOUR POWER PLANT is on our F-6 Contract

Read What You Get

1. Good Public Relations

It is difficult for you to fire men and keep good public relations. The F-6 contract puts this up to us. At the end there will be no hangovers for the operating payroll. You avoid ill-will should a local general contractor get into financial troubles and fail to finish.

We are independent. No connection with any utility nor are we under the Holding Company Act.

F-6 is an arm's length transaction. Actual cost of the plant is, therefore, definitely established for later rate cases.

2. Speed and Early Completion

Experienced crews ready to start at once.

Excavation and foundations may be started promptly before plans and specifications completed.

"On time" jobs—scheduled and expedited by management methods. The only sure way.

At the finish, the job is cut off sharp and clean.

One plant actually put in operation in *81 days.*

3. Low Cost and Good Work

No incentives in F-6 contract to run-up cost, as there is on the cost-plus percentage basis.

No incentives in F-6 contract to skimp or to incur extras, as in the illusory lump-sum contract.

F-6 eliminates general contractor's excessive profit and risk factor.

Avoids *costly extras.* If you have had first-hand experience with extras you know their cost.

F-6 permits the best selection of subcontracts—not possible in a lump sum bid. Changes can be made after starting work.

What You Pay—

A flat fee that is fixed by contract before work starts.

We know this business. We know what you want. And most important of all, we *cooperate.*

One of the largest companies in the world has used our F-6 arrangement for 15 years, to their entire satisfaction.

Let us quote on your work.

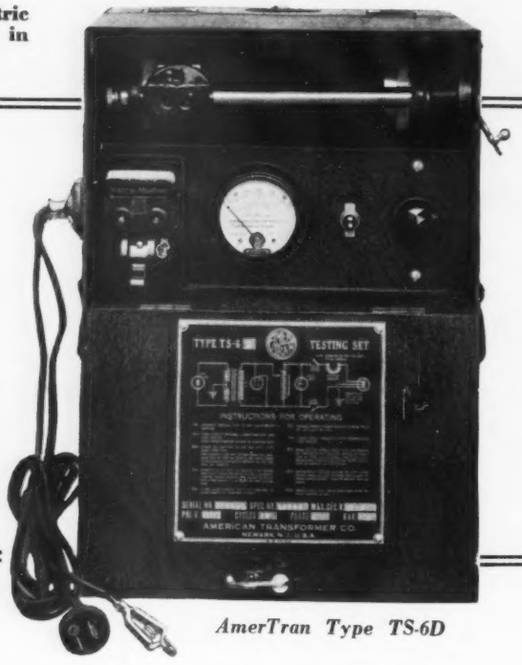
NEW YORK PHILADELPHIA CHICAGO DALLAS

A Complete Oil Test Set*

* For testing the dielectric strength of insulating oil in the field.

Features:

1. Portable
2. Accurate
3. Foolproof
4. Inexpensive



AmerTran Type TS-6D

ALL the advantages of a laboratory for testing the dielectric strength of insulating fluids have been built into AmerTran type TS-6D, yet it is portable. Voltage may be increased gradually from zero to 33,000 volts; inaccuracies due to switching surges are prevented; and an accurate meter indicates the *exact* breakdown voltage. A door switch and circuit breaker make the unit both safe and foolproof.

Left: Rear view showing bakelite test cup and safety door switch.

Below: Closed and ready to ship with everything inside.

AMER TRAN

Send for Bulletin No. 1132

SPECIFICATIONS

AmerTran Type TS-6 Oil Test Sets

CAPACITY: 0.5 Kva.

PRIMARY: 110 volts, 60 cycles.

SECONDARY: Continuously adjustable in small increments from 0 to 33,000 volts.

EQUIPMENT: Air-cooled testing transformer; crank-operated potentiometer; bakelite test cup; 0-33 Kv. voltmeter; circuit breaker; line switch; pilot light; cord and plug; instruction plate.

MOUNTING: Equipment is completely enclosed in a portable steel case equipped with handles. High voltage parts are covered during use.

DIMENSIONS: 16" H x 12⅛" W x 12½" D.

WEIGHT: 75 lbs. net.

AMERICAN TRANSFORMER COMPANY

178 Emmet St., Newark, N. J.

AMERTRAN

QUALITY TRANSFORMERS SINCE 1901

American Transformer Company Newark N.J. U.S.A.

This Water Heating Business

[*Continued from page* 33]

simplicity and cheapness, following a trend of complicated and expensive equipment intended to reduce the theft of current, but not succeeding so very well. An instance of co-operation between sales and engineering departments came up recently. Cost of an entrance cabinet with switch, etc., for electric range circuit was reduced from $9.50 to $3.50. We may expect general progress in this direction.

Turning to the carrier-current method of control, we find this yet in the experimental stage. It offers attractive possibilities, but it contains technical problems not yet cleared up. The flexibility of control offered is one of the chief points in its favor; relative expense of investment as opposed to clock control has been one of the barriers to date. High-frequency current requires generating equipment in the plant, while the relay switches on the customers' premises are somewhat higher in cost than the clock controls. Authorities such as C. P. Randolph say that a water heater saturation of 15 per cent is needed to make carrier control economically desirable. Even this means little unless the water heater customers are massed on feeder lines converging in selected substations.

According to Mr. Randolph there are six control systems of this kind, and a seventh is being installed, in the United States. Three are used for street lighting by the United Electric Light Company of Springfield, Mass.; Edison Illuminating Company of Boston and the Bureau of Power and Light of Los Angeles. The three for controlling water heating are in municipal plants at Idaho Falls, Idaho; Ames, Iowa, and Norwood, Mass. The first carrier-current water heater control system of a private utility in this country is that now being installed in Boise for the Idaho Power Company, which has been notably successful in building up water heating business.

Rumors have been heard of the impending development of a direct-current method of control to operate over existing alternating current wire systems. This is said to be technically impossible, according to existing rules, but none the less reports are in circulation that something revolutionary may be definitely announced soon. If perfected it is said to promise extremely low investment cost.

Our PROBLEM... *Your* PROFIT!

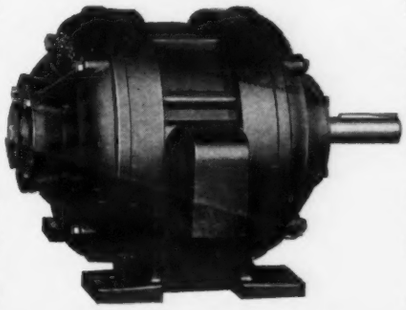
Thirty years ago we were confronted with a serious problem. We built a vast line of rugged power-driven machinery for such tough jobs as rock and ore crushing plants, for the mining and metallurgical industry, for pumping, for cement and saw and flour mills, just to mention a few of them.

Our machinery was designed and built for these tasks and was easily equal to them, but we had to have a motor that could take the beating that these applications required and measure up to the standards demanded by Allis-Chalmers Engineers.

The problem got worse and bigger until it resolved itself into one answer . . . to build our own motors. It was thirty years ago that we set about meeting our need . . . and did it.

Through this period of thirty years, the progressing knowledge and experience of all the various departments of our vast and diversified engineering organization have surely and painstakingly been built into Allis-Chalmers Motors, making them the sturdiest motors on the market—bar none.

Their great mechanical strength reduces maintenance costs to the minimum and extends their life beyond that of all less sturdily constructed motors. That is why, today, Allis-Chalmers Motors EXCEL and are the most profitable motor buy on the market.



The Allis-Chalmers Mfg. Co. builds standard motors of every type from 1 hp. up—also motors for special application.

MOTOR DIVISION

ALLIS·CHALMERS

MILWAUKEE WISCONSIN

GENERAL CONTROL COMPANY

Engineers
Develops
Contracts
Manufactures
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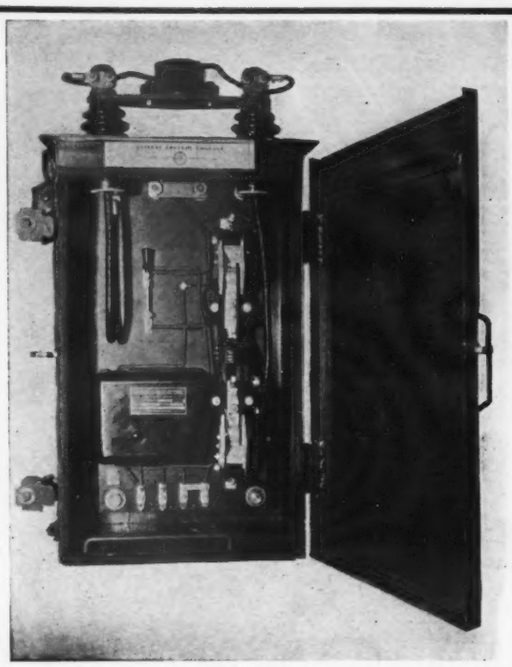
All kinds of electric

CONTROL SYSTEMS

Combining and Adapting standard and special equipment to form a complete device or system, in answer to a demand for quick, low cost, Satisfactory Results!

Let us solve Your Control Problem!



Automatic Voltage Booster Panel for Utility Rural Lines. An economic practical Development.

GENERAL CONTROL CO.
CAMBRIDGE MASSACHUSETTS

STILL IN THE LEAD

P&H

Guaranteed Saturation

PROCESS POLES

Lower maintenance costs and longer pole life are assured by the "P & H" Guaranteed saturation of at least thirty-six pounds of preservative per cubic foot to a sapwood depth of one-half inch throughout the ground-line area.

Prompt Shipment... Western Red or Northern White Cedar Poles

Saves pole money for you

PAGE AND HILL CO.
MINNEAPOLIS, MINNESOTA

Wired Radio Controls Galvanizing Process

[*Continued from page 43*]

on the line the maximum number of hours without adding to the substation peak. The economy effected by the use of electric heat in comparison with previous methods is more than satisfactory. This, combined with a capital investment savings due to longer equipment life, will pay for the complete installation in about three years. Automatic temperature control, absence of gas fumes and the cooler room temperature give better working conditions and result in materially increased production.

The kettle has been operating on the 180-volt tap (46 kw.) and has handled as high as 1,500 lb. per hour for one or two-hour periods without serious drop in zinc temperature. At the same time an average of between 600 and 700 lb. per hour has been easily maintained over full-day periods and by working some night shifts a monthly output of 170,000 lb. has been reached. More than four months operation shows that an off-peak rate of 1 cent per kilowatt-hour is directly comparable to a bare oil cost of 6.67 cents per U. S. gallon, leaving the previous costs of oil pumping, air compressing, burner attendance and maintenance as direct operating savings.

The costs for electric power have been of the order predicted by our calculations and are very gratifying.

The wired radio control system has operated as expected, keeping the kettle on the line at all times except when the substation load reached cut-off values. The average is about two cut-off operations per week at the values set, although there have been times when an unusual electric range peak prior to the summer lighting peak caused two off-peak operations of the control the same evening.

Experience with this type of off-peak industrial heating load points toward other possibilities of such control application where proper study is made of the thermal and economic conditions.

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Merger in Georgia Approved

Federal Power Commission has approved the sale of the Folkston Power Company, Folkston, Ga., to the Georgia Power & Light Company, Valdosta.

ROEBLING

Rubber Insulated CABLES

This three conductor, stranded, rubber insulated power cable shown is but one of the complete line of Roebling rubber-insulated Wires and Cables.

These cables are made to exacting specifications, for requirements of power transmission, lighting and signal service—underground, submarine or aerial. Available in a wide range of sizes and voltages. Armors: steel, zinc or bronze tape; or round steel wire.

The complete line includes:—Plain Rubber 60% Sheath Power Cable. "SAFECOTE" Rubber-insulated and Braided Wires and Cables: Code, Intermediate, 30% and 40% Performance, 35% and 40% Performite. 40% and 60% Sheath Flexible Cords. Parkway, Service, Mining, Welding, and Control Cables; Tree Wire.

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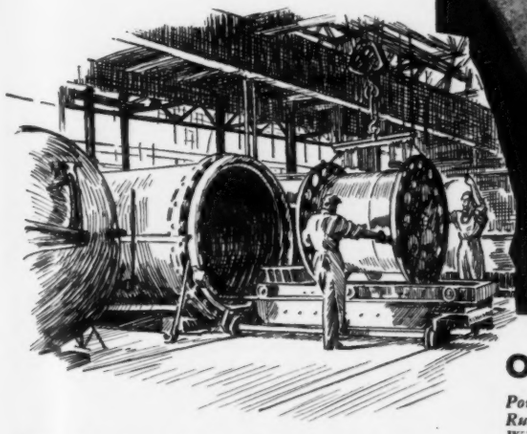

Sketch of a vulcanizing operation at Roebling, one of many closely controlled processes in the making of high quality Roebling Rubber Insulated Cables.

OVER 60 OTHER TYPES

Power Cables: Paper; Cambric; Rubber » Parkway Cable » Tree Wire » Service Cables » Station Cables » Rubber Covered Control Cables » Rubber Covered Wires and Cables: Code; Intermediate; 30% and 40% Performance; 35% and 40% Performite; Plain Rubber 60% Sheath Power Cable and 40% or 60% Sheath Flexible Cords » Weatherproof Wires and Cables » And many other wires and cables.

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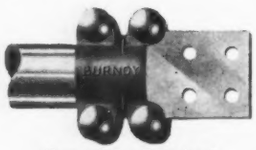
Type XD Expansion Stud Connector. Protects your bushings against temperature changes, settling and shock.

Type CT T-connector with extended arm that distributes flexure and gives added safety to your important T-connections.



Type NA Terminal

Type NS Coupler

These and many other Power Connectors are described in Bulletin No. 788

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Sales Opportunities

WATERLOO, IOWA—Iowa Public Service Company, Fort Dodge, Iowa, has approved plans for addition to steam-operated electric generating plant on Cedar River, Waterloo, including improvements in present plant. Installation will include a steam turbo-generating unit and accessories, high-pressure boilers and auxiliary equipment, with switchboard and bus apparatus. Work will begin soon. Company will also make extensions in transmission lines in this area. Cost close to $600,000.

BALTIMORE, MD.—Glenn L. Martin Company plans installation of motors and controls, transformers and accessories, regulators, conveyors, electric hoists and other equipment in new additions to aircraft-manufacturing plant in Middle River district, comprising main one-story unit, 300x500 feet and group of smaller structures. Project will be carried out during 1937. Cost about $2,000,000. Taylor & Fisher, 1012 North Calvert Street, Baltimore, are architects.

GLENDALE, CALIF.—Plans early construction of about 22 miles of 34,500-volt, three-phase transmission lines for municipal power service. Work will be carried out by day labor.

KANSAS CITY, MO.—United States Engineer Office, Manufacturers' Exchange Building, receives bids until February 5 for one diesel engine-driven electric generating set (Circular 381); also, until February 8, for one steam engine-driven electric generating set (Circular 388).

LOBELVILLE, TENN.—Tennessee Electric Power Company, Chattanooga, plans extensions in transmission line from Linden to Lobelville, about 14 miles, where local distributing system will be taken over, improved and extended; company will furnish service at this place and neighboring parts of Perry County in future. Also, will build transmission line from Charleston to Tasso, about 10 miles, where rural service will be supplied. Extensions will be made in transmission system in vicinity of Stewart, Polk County, where local distributing lines are being purchased. Permission has been secured.

JACKSON, MICH.—Goodyear Tire & Rubber Company, Akron, Ohio, plans installation of motors and controls, regulators, conveyors, electric hoists and other equipment in new multi-story plant, 150x650 feet, for manufacture of tires and tubes on site recently acquired at Jackson. Erection contract has been let to Austin Company, Curtis Building, Detroit, Mich. Completion is scheduled early in the summer. Cost about $3,000,000.

ORD, NEB.—North Loup Hydro-Electric & Irrigation District, Ord, E. H. Dunmire, engineer and manager, has plans under way for new hydroelectric generating plant on Loup River, Valley County. Project will include transmission lines, power substations and switching stations. Cost about $2,000,000. Financing has been arranged through Federal aid. Black & Veatch, 4706 Broadway, Kansas City, Mo., are consulting engineers.

PORTLAND, ORE.—United States Engineer Office, Second District, Pittock Block, receives bids until February 11 for quantity of 15 kv. circuit breakers, metal-enclosed buses, auxiliary equipment and accessories, with spare parts (Circular 232).

OKLAHOMA CITY, OKLA.—Oklahoma Gas & Electric Company plans new steel tower transmission line from steam-electric generating plant on Horseshoe Lake, near Harrah, Okla., to Oklahoma City, where additional power substation facilities will be provided. Cost about $500,000. Work scheduled to be carried out during 1937. Company is also planning new transmission line to Durant, Okla., and vicinity.

LE SUEUR, MINN.—Receives bids until February 8 for extensions and improvements in municipal electric power plant, including new diesel engine-generator unit with accessories, exciter and other equipment. Cost estimated at $50,000.

MILWAUKEE, WIS.—Milcor Steel Company, West Burnham Street, plans installation of motors and controls, conveyors, electric hoists, cranes and other equipment in new addition to sheet metal products plant. Cost close to $1,000,000. Company is a subsidiary of Inland Steel Company, 38 South Dearborn Street, Chicago, Ill.

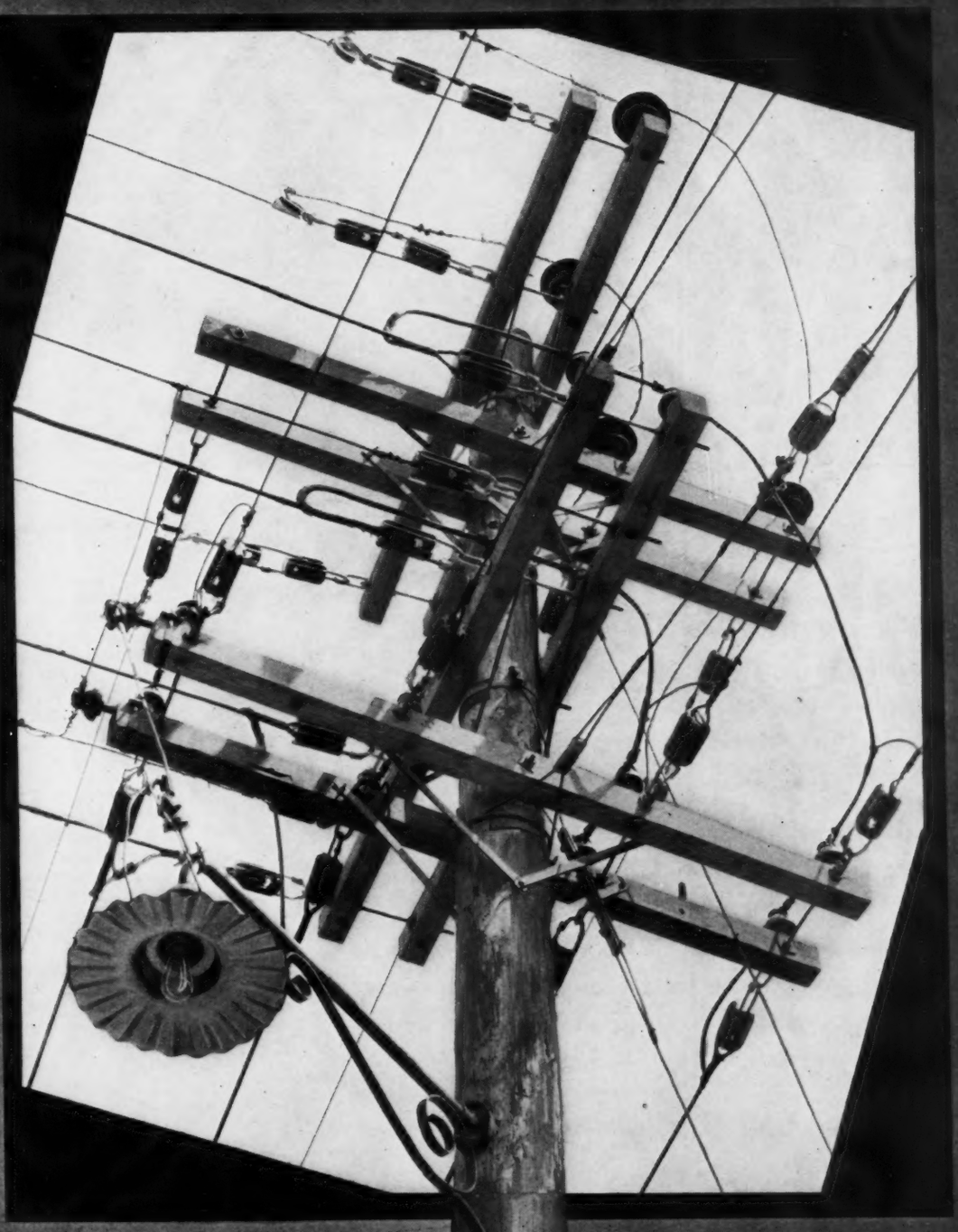
KNOXVILLE, TENN.—Director of Purchases, Tennessee Valley Authority, Knoxville, receives bids until February 4 for electrical conductor for rural electrification lines in Tennessee Valley area, totaling about 450 miles of conductor having a resistance not exceeding 1.41 ohms per mile, and 350 miles of conductor with resistance not exceeding 2.24 ohms per mile, with splicing material, armor and tie wire for conductor, and accessories; also, until February 5, for control and distribution switchboard for operating building at power station at Chickamauga Lock.

BETHANY, OKLA.—Earl W. Baker Utilities Company plans primary and secondary lines in parts of Oklahoma County, totaling about 95 miles, comprising third unit of rural electrification project. Power substation and service facilities will be installed. Fund of $85,000 has been secured through Federal aid.

MANVILLE, N. J.—Johns-Manville Corporation, 22 East Fortieth Street, New York, N. Y., manufacturer of roofing and building materials, insulation products, etc., plans extensions and improvements in power plant at branch works at Manville, including installation of additional equipment. Motors and controls, regulators, conveyors and other equipment will be installed in new additions to be built at same plant, comprising several large units. Entire project will cost about $1,000,000 and will be carried out during 1937.

SPRINGFIELD, MO.—Springfield Gas & Electric Company has plans under way for expansion and improvements in local steam-operated electric power plant, including installation of new 12,500-kw. steam turbo-generator unit with accessories, exciter, high-pressure boiler and other steam equipment. Work is scheduled to begin soon. Cost close to $650,000.

ROCK ISLAND, ILL.—United States Engineer Office, Rock Island, receives bids until February 10 for power, control and lighting system at Lock and Dam No. 21, Mississippi River, including switchboard, lock-lighting system, transformers and regulators, transformer installation for incoming line, remote control switch cabinets, limit switches, incoming power line lock-grounding system, dam power system, dam conduit system, dam power feeders and connections, dam lighting system transformers and automatic selector switch, navigation-light system, service bridge-lighting system, storage yard lighting system, portable lighting units, signal system, gasoline-electric standby power unit, electric tow-haulage unit, central control station service power and lighting system feeders and automatic emergency lighting system, hand-operated traveling-bridge crane, sump pump and complete auxiliary electrical apparatus (Circular 119).



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Recent Rate Changes

PACIFIC GAS & ELECTRIC COMPANY has announced a rate reduction applying to its consolidated system which is to become effective on February 1 and which is estimated to save its customers approximately $3,000,000 annually. All classes of service are benefited to some extent, but the reductions apply chiefly to domestic and commercial use. While the reduction is system wide and there are slight differences in the rates applying to different geographical divisions, percentages by which the rates are lowered are generally uniform. The first two blocks are shortened and the kilowatt-hour charge on each block is cut. In the major cities of the system the first block is shortened from 40 to 35 kw.-hr. and the price is reduced from 4 cents to 3.6 cents per kilowatt-hour. The second block is shortened from 200 to 165 kw.-hr. and the price cut from 2.5 cents to 2.2 cents. All consumption in excess of 200 kw.-hr. is fixed at 1.2 cents. Previous charge was 1.5 cents per kilowatt-hour for all in excess of 240 kw.-hr. This low price of 1.2 cents per kilowatt-hour applies to the third block of domestic use over the entire system. Similar reductions are made in charges for commercial lighting in which both small and large users of electricity will share. This is the second reduction in electric rates within thirteen months. The previous cut, instituted on January 1 last, totaled $4,000,000, bringing the total annual saving since that date to $7,000,000.

LOWELL ELECTRIC LIGHT CORPORATION has prepared a new rate schedule which it is estimated will save customers $125,000 a year, effective February 1. Both domestic and commercial users are included. The Massachusetts Department of Public Utilities has the rates under advisement.

ARKANSAS UTILITIES COMMISSION has announced a reduction in the rates of the Oklahoma Gas & Electric Company which will make possible an annual saving of $11,700 to electric customers of the company in Fort Smith, Ozark, Van Buren and other towns in that section of Arkansas. The reduction was voluntary on the part of the company and was made possible by recent refinancing.

NEW ENGLAND POWER ASSOCIATION properties in Massachusetts have announced proposed rate reductions since January 1 aggregating $400,000 per year. If approved by the utilities department, Malden Electric will cut $180,418, of which domestic consumers will save $120,000; Wachusett Electric and Leominster Electric Light & Power will shave off $30,815; Lowell Electric Light, $125,000 and Haverhill Electric, $60,000.

BLACKSTONE VALLEY GAS & ELECTRIC COMPANY has voluntarily reduced street lighting rates approximately 10 per cent in Pawtucket, Woonsocket and four other municipalities served. Pawtucket will consequently pay the company $60,000 for 1936 service, having withheld settlement pending the rate cut, which totals $14,226 for the communities above named.

BROAD RIVER POWER COMPANY's new rate schedule, calculated to save consumers in the company's territory $65,600 annually, has been approved by the South Carolina Public Service Commission. The new rates will affect all bills rendered after February 1. From the total reduction, residential consumers will benefit by $33,000, commercial and small power consumers, $19,000 and gas consumers $13,600. Most of the cuts were made in the lower brackets.

SPRINGFIELD GAS & ELECTRIC COMPANY has been ordered by the Missouri Public Service Commission to reduce its rates to affect an annual saving of $178,788. The order directing the reduction came as a compromise after the utility company had opposed an earlier order calling for a reduction of $215,000 annually.

WISCONSIN PUBLIC SERVICE COMMISSION has announced that electric, telephone, gas and water rate reductions totaling $2,325,024 were ordered or authorized for 580,706 customers during 1936. Of these reductions $1,971,896 were permanent and will recur each year; $298 were temporary, and $352,830 were extensions of existing reductions. Electric rate reductions were $1,043,047 for 129,352 customers.

PAUL SMITH'S ELECTRIC LIGHT & POWER & RAILROAD COMPANY has filed revised electric schedules with the New York Public Service Commission which are estimated to save consumers approximately $37,100 annually. An all-purpose residential rate is substituted for the present general lighting rate and separate meter cooking, heating and refrigeration rate.

PEOPLES GAS & ELECTRIC COMPANY OF OSWEGO and the FULTON LIGHT, HEAT & POWER COMPANY have filed revisions of their commercial and industrial rates with the New York Public Service Commission. The rates are identical for both companies and the changes made are the same in both cases. Savings to consumers will total $39,300 for users of both companies. Of this the customers of the Peoples company will save $20,100 and the customers of the Fulton company will save $19,200.

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Municipal Plants

ALLEGAN, MICH.—Suit of the city against the Consumers Power Company has been transferred from the Circuit Court to federal court as the result of Circuit Judge Fred T. Miles' action in granting the petition of the company for such transfer. The suit seeks to restrain the utility from placing poles on the streets and otherwise extending its activities in the city and follows closely the authorization of the city to build and equip a municipal power plant.

OWOSSO, MICH. — Petitions asking the city commission to proceed with construction of a municipal light and power plant have been presented for that body's consideration. The petitions carried 1,500 signatures. Petitions ask that revenue bonds be issued to finance the plant. According to Mayor John N. Axford it will be necessary to amend the city charter before the bond issue can be voted on because the charter does not provide for the issuance of revenue bonds.

LAKE CRYSTAL, MINN.—By a vote of 461 to 179 citizens voted on January 12 a $45,000 bond issue to construct a light plant. The twenty-year franchise of the Northern States Power Company expires in April.

ROCKY MOUNT, N. C.—Board of Aldermen has effected a 20 per cent reduction in the electric rates of the municipal plant affecting approximately 5,000 users. The cut amounts to $60,000 annually. New rates are residential, 5 cents per kilowatt-hour for first 50, 3 cents for next 50 and 2 cents for next 50 and 1½ cents per kilowatt-hour for all energy in excess of 250; commercial, 5 cents for first 300 kw.-hr., 4 cents for next 700 and 2 cents for all over 4,000.